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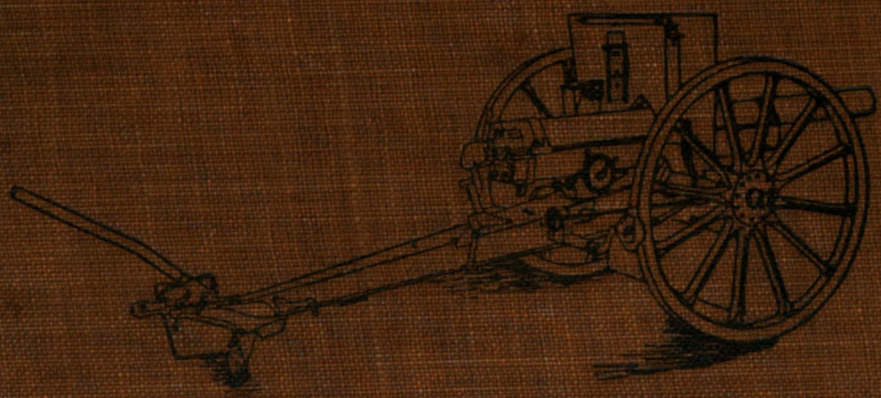
MODERN ARTILLERY IN THE FIELD

COLONEL H. A. BETHELL



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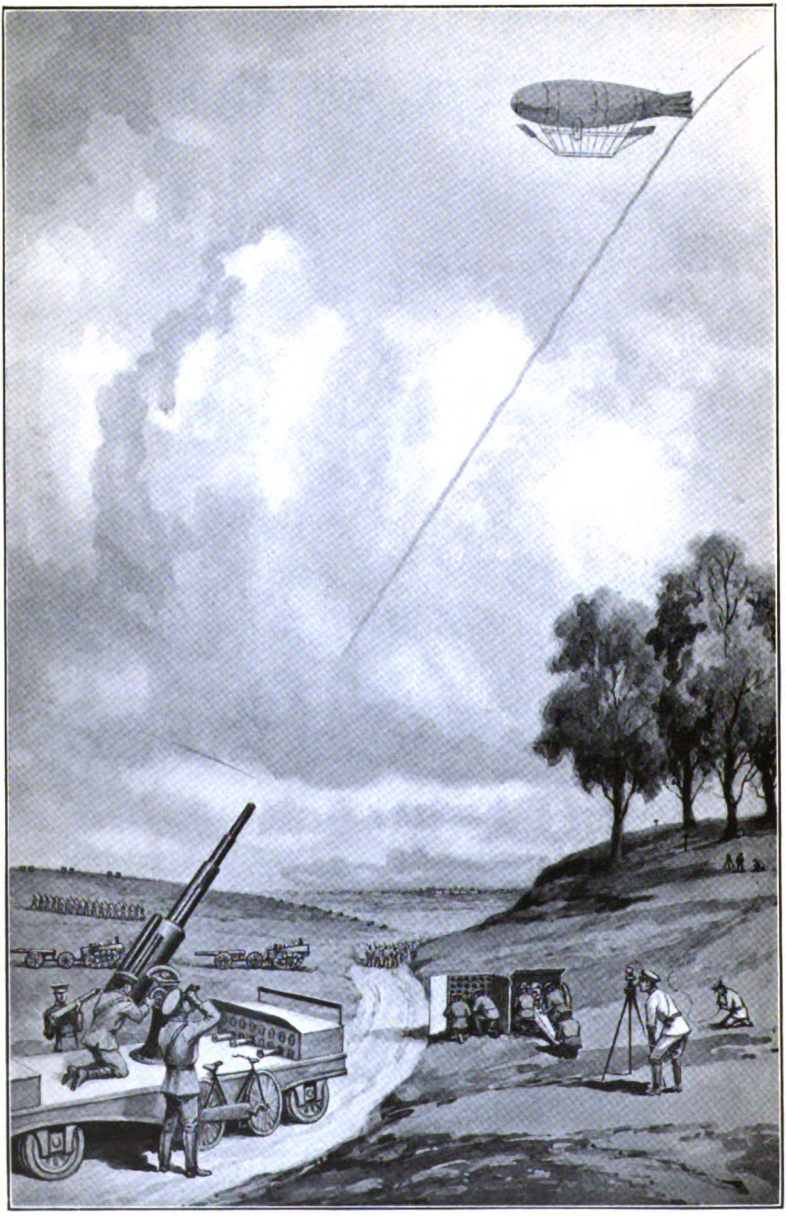

MODERN ARTILLERY IN THE FIELD.

Frontispiece.

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MODERN ARTILLERY IN THE FIELD

A DESCRIPTION OF THE ARTILLERY OF THE FIELD ARMY, AND THE PRINCIPLES AND METHODS OF ITS EMPLOYMENT

BY

COLONEL H. A. BETHELL, R.F.A.

(RETIRED)

AUTHOR OF 'MODERN GUNS AND GUNNERY'

MACMILLAN AND CO., LIMITED

ST. MARTIN'S STREET, LONDON

1911

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AMENDMENTS, 1912.

THE Provisional Regulations for Field Artillery Training, 1912, announce certain small but important improvements in our 18-pr. field gun equipment, and changes in our ranging procedure which these improvements have enabled us to carry out.

The time fuze (see page 126 of this book) has been considerably improved, so that the error at 2000 yards is only 48 yards, as against 77 yards with the original fuze. This enables us to burst the shell much closer to the target without risk of wasting too many shell on graze, and the best distance of the mean point of burst from the target is now laid down as 70 yards at 3000 yards, corresponding to an angular height of burst of only 10 minutes instead of 15 minutes.

The present 18-pr. shrapnel contains 375 bullets of 41 to the pound instead of 365 of 42 to the pound, and its shooting has been improved. The gun, under experimental conditions, will now make the following percentages of hits on a gun-shield 4 ft. 6 ins. by 5 ft.:

At 2000 yards, - - - -	60 per cent.
„ 2500 „ - - - -	33 „
„ 3000 „ - - - -	16 „
„ 3500 „ - - - -	8½ „
„ 4000 „ - - - -	5 „

The improved accuracy of the fuze has enabled us to adopt time shrapnel ranging (page 162) as the normal method. The new method is known as *collective ranging*

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and consists of firing three rounds of time shrapnel, at the same elevation and fuze, from each half-battery in turn, till a 300-yards' bracket is found and again subdivided so as to give a 100-yards' bracket. Fire for effect is then immediately commenced at the mean of this bracket, without waiting to fire a fuze echelon, as the corrector setting will have been determined during the ranging. The principle of collective ranging is the same as that of the method of section ranging described on page 161, but with three shell at each elevation instead of one. The increased number of shell used reduces the chance of the ranging officer being misled by an abnormal round, or by errors of observation. The older methods of ranging may still be used at easy targets.

In four-gun batteries, such as our Territorial batteries, all four guns are fired at each elevation.

Note to page 213.

The French corps artillery is looked upon as a floating reserve which is constantly being expended to provide batteries for certain tasks, and constantly re-constituted by other batteries which have completed their tasks.

Page 215.

Divisional communication companies are now called *signal companies*. Their organization, as now laid down, is as follows:

DIVISIONAL SIGNAL COMPANY.

3 cable detachments, each with 10 miles of cable and staff for 3 offices.

4 mounted orderlies, 8 cyclists, and 9 motor cyclists, all signallers.

3 mule-pack cable detachments, each with 8 miles of cable and staff for 10 offices, and each with 8 cyclist signallers.

Altogether 6 officers and 140 men.

The three mule-pack detachments will usually be allotted to the three infantry brigades; the remainder will be

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divided into two echelons according to requirements, the smaller echelon being with the G.O.C. and the larger following in rear of the infantry.

Page 219.

The scheme of ammunition supply has recently been modified in our own army. The old divisional ammunition column, which used to consist of 133 wagons, has been transferred to the Army Corps, and provided with motor transport. In place of it, the brigade ammunition columns have been split up, about half of each going to make the new divisional ammunition column, while the remainder accompanies the brigade. The new brigade columns will be much handier than before. The number of rounds carried in the field is unchanged.

Page 222, *footnote.*

Field Artillery Training, 1912, now for the first time lays down that the G.O.C. Division is at all times responsible for the tactical employment of his artillery, and that the tasks assigned to the artillery are to be included in divisional operation orders, so that the infantry may know what support to expect.

Page 232.

It is now laid down that for signalling purposes the letter "o" is to be pronounced "ow."

Page 259.

The distance occupied on the road by a division (not including the divisional ammunition column, which marches 3 to 4 miles in rear) is now reduced by about 2000 yards. See previous note to page 219.

Page 316.

The French no longer divide the batteries into supporting and protective artillery at the outset of the battle. Instead of this, the batteries are assigned tasks as may be necessary, either as "infantry batteries" or as "counter-batteries."

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The former are ordered to co-operate with certain infantry units, while the latter are assigned zones in which to watch for and engage the enemy's artillery.

Page 373.

The French dirigible "Adjutant Réau" recently created a record by rising to a height of 8000 feet with 6 men.

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PREFACE.

THIS book is intended for those who have to handle artillery in the field, and for those who have to fight with and against modern quick-firing guns. All theoretical subjects, such as the science of ballistics and the theory of gun-building, have therefore been excluded, and the endeavour has been to give such information as will be of practical use to staff officers, gunners, and officers of cavalry, infantry, and engineers. This information is not limited to our own service, but includes a brief description of the artillery material, organization, and tactics of the principal foreign armies.

The author has endeavoured to arrange the contents of the book in logical sequence. Part I deals with the material at the disposal of the gunner, Part II with its technical employment, in which the enemy is considered merely as a target. Part III describes the interior economy of the artillery arm in the field, including such matters as organization, formations, and ammunition supply; and Part

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IV deals with the tactics of artillery in combination with the other arms.

The book contains one element of novelty. The action of artillery from and against air-craft, and the effect upon artillery tactics of the aerial arm, have been discussed as fully as the information at present available permits.

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CONTENTS.

PART I. EQUIPMENT.

CHAPTER		PAGE
I.	THE Q.F. FIELD GUN	1
II.	THE Q.F. FIELD HOWITZER	35
III.	HEAVY FIELD GUNS AND HOWITZERS	40
IV.	HORSE AND MOUNTAIN ARTILLERY	46
V.	THE Q.F. BALLOON GUN	56
VI.	AMMUNITION	86
VII.	ARTILLERY DRAUGHT	97
VIII.	ARMS AND STORES	111

PART II. PRACTICAL GUNNERY.

IX.	FIELD ARTILLERY FIRE	122
X.	FIRE DISCIPLINE	142
XI.	ENTRENCHMENTS	197
XII.	MISCELLANEOUS	206

PART III. MINOR TACTICS OF ARTILLERY.

XIII.	ORGANIZATION	212
XIV.	COMMAND	223

Digitized by Google

CHAPTER		PAGE
XV.	Reconnaissance	233
XVI.	Camps and Quarters; Outposts.	248
XVII.	Marches	254
XVIII.	Manœuvre	261
XIX.	Artillery Positions	269

PART IV. COMBINED TACTICS.

XX.	Modern Q.F. Tactics	280
XXI.	Artillery Tactics against the various Arms	296
XXII.	Tactics of Horse and Mountain Artillery	306
XXIII.	The Support of Infantry by Artillery	315
XXIV.	Artillery with Advanced and Rear Guards	326
XXV.	Artillery in Attack, Defence, and Encounter	330
XXVI.	Artillery in Night Operations	349
XXVII.	Field Artillery in Fortress Warfare	359
XXVIII.	Employment of Artillery under Special Conditions	365
XXIX.	Artillery in Aero-Naval Warfare	369
	Index	382

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LIST OF PLATES.

PLATE		FACING PAGE
	MODERN ARTILLERY IN THE FIELD . .	*Frontispiece*
I.	GOERZ PANORAMA TELESCOPE	21
II.	SCHNEIDER 14·3 PR. DIFFERENTIAL RECOIL FIELD GUN IN FORWARD POSITION, 1910 . . .	29
III.	KRUPP 4·7 IN. FIELD HOWITZER, 1910 . .	38
IV.	COVENTRY ORDNANCE WORKS 4·625 IN. FIELD HOWITZER, 1910	39
V.	KRUPP 4·2 IN. HEAVY FIELD GUN . . .	40
VI.	VICKERS MAXIM 6 IN. HEAVY FIELD HOWITZER, 1910	43
VII.	KRUPP 6 IN. HEAVY FIELD HOWITZER . .	45
VIII.	MOUNTAIN ARTILLERY WITH EHRHARDT GUNS .	47
IX.	VICKERS MAXIM MOUNTAIN GUN, 1910 . .	50
X.	KRUPP 12 PR. BALLOON GUN ON TRANSPORTABLE PLATFORM	74
XI.	VICKERS MAXIM 3 PR. BALLOON GUN, 1910 .	77
XII.	EHRHARDT QUICK-FIRING FIELD GUN WITH TEAM, SHOWING GERMAN SYSTEM OF DRAUGHT .	97
XIII.	ARMSTRONG 14·3 PR. FIELD EQUIPMENT WITH COMPRESSED AIR RUN-UP, 1910 . . .	296

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PART I.

EQUIPMENT.

CHAPTER I.

THE Q.F. FIELD GUN.

THE artillery taken into the field with an army consists of

Field guns.	Heavy field guns.
Light field howitzers.	Heavy field howitzers.
Horse artillery guns.	Balloon guns.

In mountainous countries these are supplemented or replaced by

Mountain guns, and
Mountain howitzers.

In countries where pack animals cannot be used, the fighting force includes

Portable guns,

divisible into loads carried by porters or coolies.

The land forces of a nation further include

Siege artillery,
Fortress artillery, and
Coast defence artillery.

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The last three natures are not dealt with in the present volume.

Field guns constitute the great bulk of the artillery of a field army, and are used for all ordinary purposes. The other types are used for special duties. It will therefore be convenient first to describe the modern field gun, and then to note the variations which differentiate the special natures of artillery.

THE Q.F. FIELD GUN.

The equipment of a brigade of three batteries with staff, which is the fighting unit in most armies, comprises the following:

Guns and limbers.
Ammunition wagons.
Special wagons, such as telephone and observation wagons.
Special stores for laying and signalling.

The brigade is followed, in the first line, by the brigade ammunition column, consisting of ammunition wagons and transport wagons; and, in the second line, by the brigade and battery transport, consisting of transport wagons and (in foreign armies) special wagons such as forge and store wagons and travelling kitchens.

The gun, considered as a travelling unit, will be described later under the head of *Draught*. Considered as a fighting unit of equipment, it consists of the gun itself, with sights, recoil gear, carriage, shield, and wheels.

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General Description of the Gun.

A Q.F. or quick-firing gun is one of which the carriage does not recoil on firing. This not only saves the time and labour required to run the carriage up after each shot, but it enables the gunners to keep under cover of the gun shield while the gun is being fired. This result is obtained by the use of the **gun-recoil carriage**. The gun itself is allowed to recoil on guides, while the carriage is held fast by a spade on the end of the trail, which digs into the ground. The recoil of the gun is checked by a hydraulic buffer, consisting of a piston working in a cylinder nearly filled with liquid, and the gun is returned to the firing position by springs or compressed air. The gun is supported and guided in its recoil by the cradle, which in foreign equipments is a steel trough under the gun, containing the recoil gear; in our own 18 pr. we use a ring cradle surrounding the gun, with the recoil gear in a separate cylinder on top. The cradle, with the gun, is elevated and depressed about its horizontal trunnions by the elevating screw. The general horizontal direction is given to the gun by shifting the trail, called traversing. For fine traversing, the cradle is mounted on a top carriage, pivoted vertically on the main carriage, and traversed by a screw; or else the cradle has a vertical trunnion pivoted in a saddle, which again is on horizontal trunnions for elevating. Or, in French equipments, the whole carriage traverses on the axletree. The lower carriage

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consists of the trail, axletree and wheels; the trail has at its point a spade to hold the carriage from recoiling, a trail eye by which it is limbered up to the hook on the limber for travelling, and a folding traversing handspike. The trail also carries seats for the gunners who lay the gun and attend to the breech mechanism, and a travelling brake, also used during firing to prevent the carriage from running forward when the gun runs up after recoil. The shield is fixed to the lower carriage, and the lower and sometimes the upper portion are hinged so as to fold on the central portion when not required. The gun is layed by open or telescopic sights, or, when firing from behind cover, by a clinometer with spirit level for elevation, and a dial sight with horizontal graduated circle for line. The gun is loaded with fixed ammunition, in which the shell and brass cartridge are combined into one as in small-arm ammunition. The breech is closed by the breech-block, which may be a screw or wedge, arranged so that it can be opened or closed by one motion of a lever. The gun is fired by a percussion lock contained in the breech-block.

The annexed illustration shows the principal parts of a Q.F. field gun.

A is the gun, sliding on the guides B in the cradle C. The cradle carries the spring-case D, containing the hydraulic buffer and the running-up springs. The cradle is supported by cross trunnions on the upper carriage E; this is pivoted vertically on the lower carriage, which consists of the axletree and the

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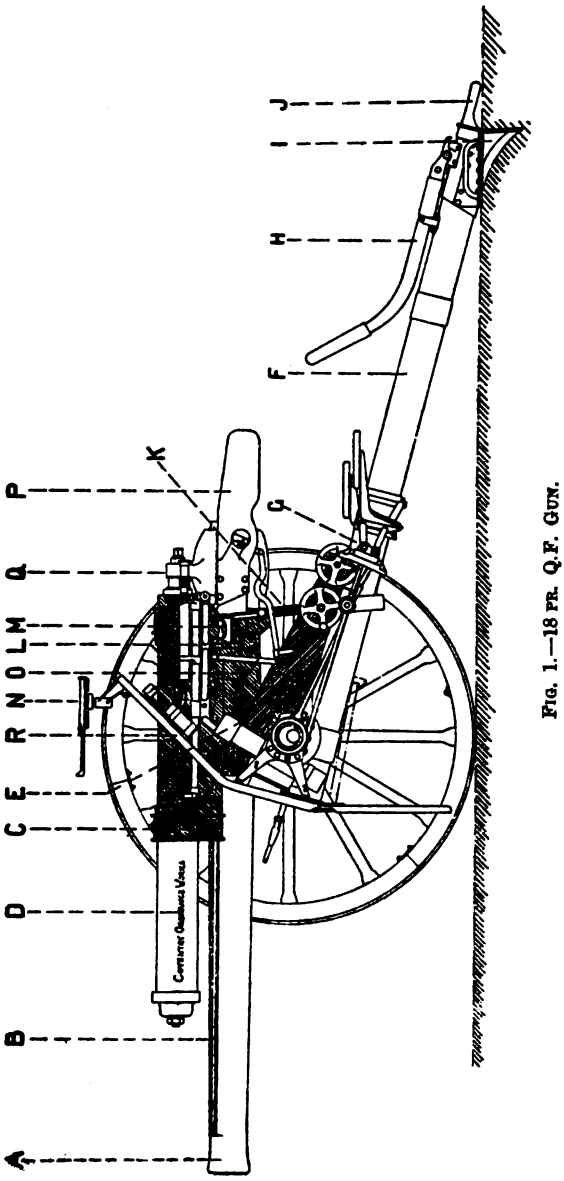

FIG. 1.—18 PR. Q.F. GUN.

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trail F. The trail carries the brake arms G, with seats for the numbers loading and firing the gun. At its rear extremity are the traversing lever H, spade I, and trail eye J. The gun and cradle are elevated by the elevating screw K. The gun is layed with the rocking bar sight L, with or without the telescope. In the concealed position it is layed by the clinometer M and the dial sight N; but the latter has now been replaced by a panorama telescope. The gun is fired by the firing lever O; the guard P prevents the firing number from getting his arm behind the gun. The horn Q on the breech connects the gun with the buffer. The detachment are protected by the shield R, of which the lower portion folds up for travelling.

Construction of Gun.

The gun itself is a nickel steel tube, made in two layers shrunk together to give greater strength. In our own service the gun is further strengthened by **wire-winding**, which consists of winding several layers of steel ribbon over the breech portion of the inner tube before the outer tube, called the **jacket**, is shrunk on. A Q.F. gun has no trunnions, but has guides or guide-blocks formed on the jacket, upon which the gun slides when it recoils. The gun is rifled with a number of small grooves, further described under *Rifling*, and the bore is enlarged at the breech to take the brass cartridge. The breech is closed by the breech-screw or **breech-block** afterwards described.

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The length of a gun is expressed in calibres, a calibre being the diameter of the bore, not including the grooves. The usual length of a Q.F. field gun, measured over all, is 30 calibres, but our own 18 pr. is somewhat shorter. The calibre of the 18 pr. is 3·3 inches, that of most foreign field-guns is 75 millimetres or 2·95 inches.

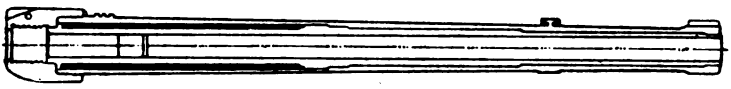

FIG. 2.—ARMSTRONG WIRE-WOUND FIELD GUN.

The annexed illustration, which represents an Armstrong field gun, shows the A tube, jacket, and breech-piece with breech-block. The wire-winding is shaded black.

Rifling.

The object of rifling is to give the shell sufficient spin to keep it point foremost during its flight. For this purpose the shell has one or more bands of soft copper fixed on it, called driving bands. The driving band, on discharge, is forced into the helical grooves cut in the bore, and so rotates the shell. The amount of spin necessary to keep the shell steady increases with its length. For an ordinary field shell, about 3½ calibres long, the inclination of the grooves should be such as to give the shell one turn in a distance of 30 calibres. This inclination is styled the **pitch of the rifling.**

The gun may be rifled with **uniform** or **increasing twist.** In the latter the inclination of the grooves is

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at first slight, and increases to the full pitch near the muzzle. The advantage of this system, which is used in Germany, is that the strain upon the walls of the shell is less than with the uniform twist, which suddenly forces the shell to assume a high velocity of rotation. The increasing twist therefore allows the walls of the shell to be made thinner, so that the shrapnel contains more bullets. On the other hand, the friction in the bore is greater and more irregular than with the uniform twist, which latter gives a higher velocity and slightly more accurate shooting, and is therefore adopted in English and French field guns.

One result of the rotation of the shell is to cause it to **drift** across the range. If the twist of the rifling be right-handed, the path of the shell curves more and more to the right as it proceeds, so that at extreme range it may pitch 500 or 600 yards to the right of the original line of fire. The complete explanation of this problem involves somewhat abstruse mathematics. For practical purposes the following explanation may be accepted:

The tendency of the spin is to keep the axis of the shell pointing in the original direction, that is, upwards. On the other hand, the pointed shape of the shell tends to make it follow the curve of the trajectory, which continues to drop below the original line of departure. The result is a compromise, and the shell travels after the fashion of a kite, with its point cocked above the direction of its motion, so that the air-pressure impinges chiefly on the lower side of

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the head. Since the shell, viewed from behind, is spinning in the direction of the hands of a clock, the effect of this air-resistance below its centre is to make it diverge to the right of its original course. And since the spin falls off but little during flight,[1] while the forward velocity is rapidly reduced by the resistance of the air, the divergence increases with the range.

It is clear that the sharper the twist of the rifling, the greater will be the drift; hence the rifling is so designed as to give only sufficient spin to keep the shell steady to the end of its flight.

Breech Actions.

The three principal systems in use are:

The interrupted screw.
The eccentric screw.
The wedge.

The **interrupted screw** is used in our own service. The breech-block has a screw thread which engages with a corresponding thread in the breech of the gun; this thread is cut away at the top and bottom of the screw, and at the sides of the breech of the gun. If the screw be turned so that the remaining threaded portions are opposite to the recesses where the threads in the gun are cut away, it can then be entered or withdrawn freely. If, when entered, the screw be given a quarter of a turn, then the threaded portions engage with the threaded portions of the gun, and the screw is firmly held. The breech-block is set in

[1] About 10 per cent. at 3000 yards for a 14·3 lb. shell.

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a steel frame called the **carrier**, in which it revolves; the carrier swings on a vertical pivot at the right-hand side of the breech. The breech-block is rotated by a lever pivoted on the carrier, having on its spindle a toothed wheel engaging with the block. When the lever is pulled back it first rotates the block till the threads are clear, and then swings the carrier and block round to the right; to allow of this motion, the recess on the left-hand side of the breech is cut deep enough to clear the end of the block as it swings.

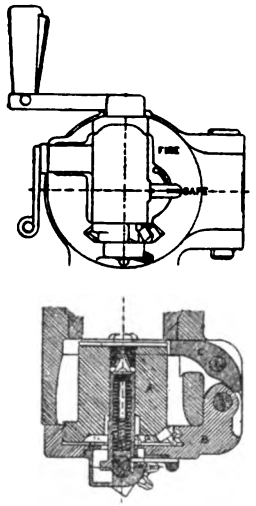

FIG. 3.

Fig. 3 shows a single-motion interrupted screw breech mechanism by the Coventry Ordnance Works. The upper figure shows the outward appearance, with the lever on top and the trigger on the left-hand side. The lower figure is a horizontal section through the action, showing the screw A (the threads are not visible, being on the upper and lower surfaces, leaving the sides plain); the carrier B, and extractor C.

The **firing gear** is seen in the centre. This consists of a striker and spring set nearly in the centre of the breech-block. A cocking piece engages with a shoulder on the striker, and draws it back against the spring for about an inch, till the shoulder slips off

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the toe of the cocking piece, and the striker flies forward, igniting the cap in the base of the cartridge. This is called a **trip-lock.** To prevent any possibility of firing the cartridge in the act of closing the breech, both the breech-block and the striker are set slightly out of centre, so that the striker is not opposite to the cap till the breech-block is turned to the locked position. A trigger connected with the cocking piece projects from the side of the carrier,[1] and engages with the firing lever, which is on the left of the cradle, convenient to the layer's hand. When the firing lever is pulled it actuates the lock mechanism and fires the gun. When the gun recoils the trigger recoils away from the firing lever; should the gun fail to run up completely, it can still be fired so long as it is within a couple of inches of the correct firing position.

The **extractor** is a forked lever pivoted in the breech, catching the rim of the cartridge above and below. The tail of the extractor projects from the right-hand side of the breech, so that the carrier strikes it as it swings round after the breech is opened, thus ejecting the empty cartridge case.

The whole action is known as the **single-motion swinging block.** It is somewhat complicated, and has a good deal of exposed bearing surface which has to be kept clean. It is, however, a very powerful action. The swinging block acts as a rammer, which drives the cartridge home, even if the chamber be

[1] In the 18 pr. the trigger is set in the metal of the breech, and enters a recess in the carrier when the breech is closed.

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foul, and the extractor will pull out any case, no matter how tight.

The swinging block action is sometimes made up with a stepped "**Welin**" screw, illustrated in Fig. 4.

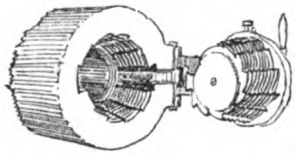

Fig. 4.

Instead of cutting away alternate segments of the screw, each is made to a smaller radius than the one preceding it, the last being plain. Thus when the screw is turned so that, say, No. 3 segment of the screw is opposite to No. 1 of the breech, the threads no longer engage, and the screw can be entered or withdrawn freely. This action is used in the later marks of our 15 pr. B.L. converted guns. It is stronger than the ordinary screw, and can consequently be made shorter. It is more difficult to keep clean on service than the ordinary pattern.

In earlier patterns of Q.F. guns, such as our 15 pr. (Ehrhardt) Q.F., the breech-screw was made conical or ogival to facilitate withdrawal. In the 18 pr. it is coned in the reverse direction, being larger towards the muzzle; this form is nearly as strong as the Welin, and much simpler.

The **eccentric screw** is used in the French service field gun. It is illustrated in Fig. 5. The breech of the gun is enlarged so as to take a breech-screw considerably larger than the bore. This screw has a longitudinal hole through it at one side, through which the shell and cartridge are inserted. When half a turn is given to the screw, the hole no longer

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comes opposite to the bore, and the breech is closed. The firing gear is similar in principle to the trip-lock already described, and the extractor is actuated by a cam groove in the front face of the screw.

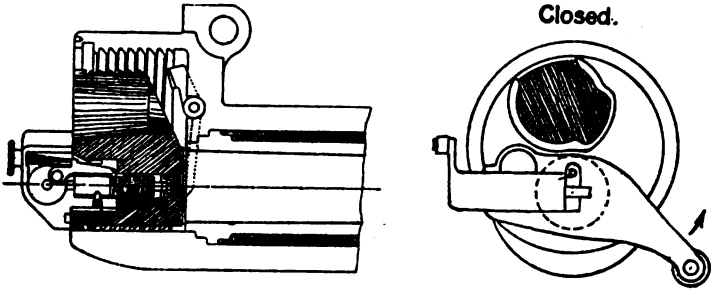

FIG. 5.—ARMSTRONG ECCENTRIC SCREW BREECH ACTION.

This is an excellent action in many ways; the parts are all enclosed, and do not suffer from the cloud of dust which arises when a gun is fired on dry ground. It is somewhat heavy, and is less powerful than the swinging block.

The **wedge breech action** is used in Germany and in all the Krupp equipments.[1] It is illustrated in Fig. 6. The wedge is a steel block of slight taper, which slides in a transverse slot in the breech. When moved to the right, the breech is open; when moved to the left, it is securely closed. The metal at the left of the breech is cut away to facilitate loading. The wedge is moved by a lever fixed to a vertical spindle, which has an arm traversing in a curved slot in the upper face of the wedge. The trip-lock is contained in the wedge,

[1] Except the Argentine equipment, fitted by request with a Welin screw.

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and the extractor is actuated by a projection on the front face of the wedge. The action is sometimes fitted with a firing lever, but the ordinary German gear is a simple pear-shaped handle linked to the trigger; the firing number pulls this handle, and it is drawn out of his hand as the gun recoils.

The wedge is the strongest and simplest of all breech actions, but is heavier than the swinging block and less powerful in loading and extracting. A minor disadvantage of the German pattern is that the firing gear has to be on the right-hand side, away from the layer; if placed on the left it would interfere with the loading.

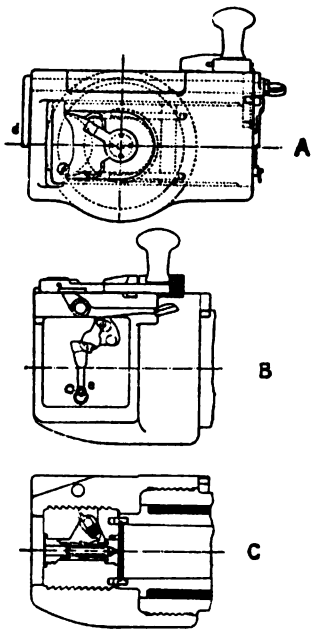

Fig. 6.

The Armstrong wedge presents many points of superiority over the German pattern. As will be seen from Fig. 6, the wedge is almost flush with the breech, instead of having 3 or 4 inches of solid metal behind it. It is held by the saw-toothed ribs shown at C; this arrangement saves about ½ cwt. of weight. The gun can be fired from either side, by the firing lever *d* or by a lanyard attached to the trigger *e*. The black shading in

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Fig. 6, C, represents the wire-winding over the chamber.

Semi-Automatic Actions.—In these the breech opens automatically during the run up, and ejects the cartridge case. It is held open by a catch attached to the extractor; when the next round is loaded it presses the extractor home, and the breech is closed by a spring. When this action is applied to the wedge, the wedge moves vertically instead of horizontally, and the spindle of the lever which actuates it is horizontal. This spindle is extended forward as a rod alongside the gun; the rod is screwed with a thread of rapid pitch, and passes through a nut on the cradle. When the gun recoils the nut revolves freely; when it runs up the nut is held by a ratchet, the rod is revolved, and the breech thrown open. On reaching the firing position the gun throws the ratchet out of gear, and the breech is then free to close when the catch is released. Similar semi-automatic gear can be used with the interrupted screw or the eccentric screw.

Rate of Fire.

This depends principally on the fuze-setting. But, so far as the breech action is concerned, a field gun with the ordinary Q.F. action can fire 20 aimed rounds per minute, while with the semi-automatic action it can fire 30. A fully automatic action, with the cartridges in a hopper over the breech like a machine gun, is made by Messrs. Krupp. This is capable of 40 rounds a minute; but the gun is only

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intended for firing a few rounds at a time at torpedo boats, as if fired continuously it would soon get red-hot.

Sights.

In a Q.F. equipment the sights are not fixed to the gun, which recoils at every round, but to the cradle or top carriage. Q.F. sights are of two types, according as the carriage is fitted for the ordinary or **independent line of sight.** The ordinary type is illustrated in Fig. 7, which represents the present German service field gun (C 96 n. A.). The curved back-sight A and fore-sight B are fixed to the cradle C, which does not recoil. The back-sight (known as an **arc sight**) is shaped to an arc struck from the tip of the fore-sight. It carries a clinometer level D for laying from the concealed position, and a short telescope E, similar to one barrel of a prismatic field glass, to assist the layer's vision.

In some equipments, such as the Austrian, the back-sight socket is set on a pivot parallel to the axis of the gun, so that the sight can be set vertical by means of a cross-level when the gun is on a lateral slope. This eliminates the error which would otherwise result from the sight sloping over to one side. Sights on this principle are styled **reciprocating** sights.

Drift.

As pointed out under *Rifling*, the shell tends to deviate to the right of the target. This is allowed

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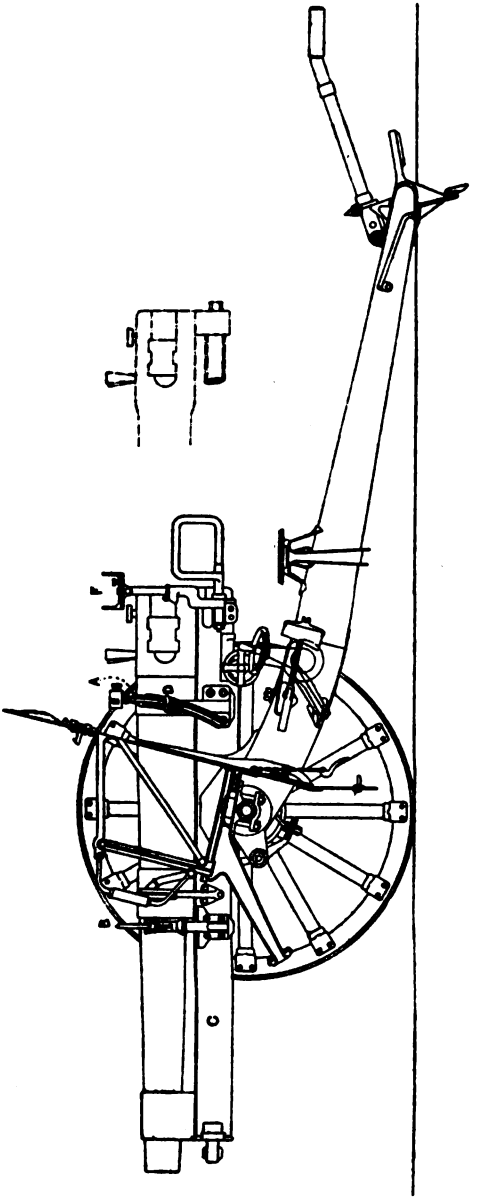

FIG. 7.—THE GERMAN SERVICE FIELD GUN (C/96 N. A.).

B

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for in various ways. When the ordinary back-sight and fore-sight are used, the former is set at an angle in its socket, so that the further it is drawn out the more the gun has to be pointed to the left of the target to bring the sights on. With the independent line of sight, as in the 18 pr., the cradle trunnions are inclined, the right trunnion being the higher, so that the more the gun is elevated the more to the left it points. In some equipments a cam is provided which shifts the foresight to the right as the gun is elevated. Except the cam, these automatic devices only give an average correction, too large at short ranges, and too small at long ones. Where great accuracy is required, the exact correction, taken from a table, is given on the deflection scale.

Deflection.

Every sight is fitted with a deflection scale for correcting small lateral errors in shooting, due to wind or other causes. This is a graduated scale upon which the back-sight notch, or rear end of the sight-bar, can be shifted to the right or left up to about 3 degrees.

The **independent line of sight** is used in the English, French, and Italian equipments. The principle is illustrated in Fig. 8, which represents the gear used in the 18 pr., looking towards the muzzle. This diagram will be more readily understood on reference to Fig. 1. The sight-bar A, carrying the sighting telescope B, is pivoted on the cradle trunnion C, and its rear end is supported by a rod attached to

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the centre of the long elevating screw D. This screw passes through a nut E on the cradle, rotated by the elevating wheel F (on the far side of the gun) and through a nut G on the upper carriage, rotated by the laying wheel H. To lay the gun, the layer

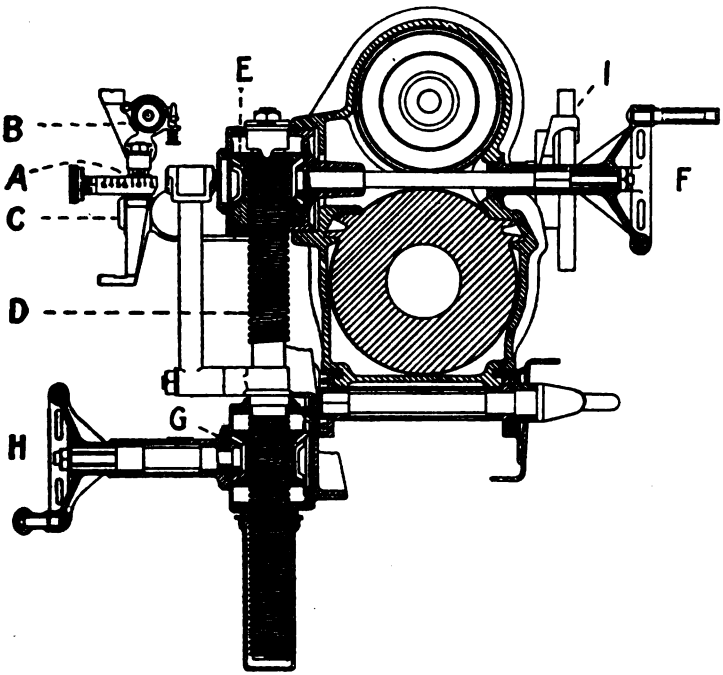

FIG. 8.

turns the wheel H till the telescope points at the target; this also elevates the gun so that it points directly at the target. To give the gun the elevation above the target corresponding to the range, the elevating number turns the wheel F; this elevates the gun without moving the telescope, which still remains pointed at the target. The amount of

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elevation given is shown on a drum at 1. This system allows the layer to keep his telescope on the target without troubling about the elevation, which can be changed in a moment without re-laying the gun.

The principal objection to the independent line of sight is the difficulty in applying to it the reciprocating principle described above. In order to eliminate the error due to difference of level of wheels, which may seriously affect the accuracy of the shooting, it is necessary that the sight should pivot about an axis parallel to that of the gun. But since the sight, with the independent system, is usually fixed to a part of the carriage which moves with respect to the gun, this is not easy to carry out. The best solution is the "**automatic**" sight patented by Col. Scott, C.B. In this the sight is attached to the cradle and correctly pivoted, but, to prevent the sight from moving when the cradle is elevated, the front of the sight-bar is supported on a cam connected to the elevating gear, which depresses the sight-bar through an equal and opposite arc, so that it does not move when the gun is elevated or depressed. Messrs. Krupp use a similar gear in which the sight is screwed up in its socket, by gearing connected to the elevating wheel, when the gun is elevated.

The 18 *pr. Sight.*

The 18 pr. has the independent line of sight, but it was not considered desirable to adopt the reciprocating system with its attendant complications. The sights are carried on a sight-bar as in Fig. 1;

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PLATE I.– GOERZ PANORAMA TELESCOPE.

To face p. 21.

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the back-sight notch and fore-sight are on an upper bar, set on a vertical pivot so as to traverse for giving deflection for wind. This bar also carries a sighting telescope, and a clinometer for use when laying from behind cover. The elevation for the range is given by the elevating wheel on the right of the gun; the range elevation above the line of sight is shown in yards on a graduated drum.

The Dial Sight.

This is used to give the horizontal direction to the gun when laying from behind cover. It is a graduated circle provided with a sighted ruler or small telescope. In field guns it is used as an accessory which can be fixed when required on the ordinary sight. The dial sight, in its simplest form, is shown at N, Fig. 1, and at E, Fig. 7.

The Goerz Panorama Telescope.

This has replaced the dial sight in most modern equipments. It is a vertical telescope with horizontal eye-piece and object glass; the hood with the object glass can be turned in any direction, so that the layer can lay on an aiming point behind him. The angle through which the hood is turned is read on a horizontal circle. The hood of the telescope projects above the gun-shield, so that the layer is protected by the shield.

The Goerz panorama sight may be noticed in Plates VI. and VII. The telescope itself is illustrated in Plate I.

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The Zeiss Zig-zag Telescope.

This is an ordinary straight telescope with a reflecting prism which can be fixed in front of the object glass so as to reflect objects to the right rear or left rear, thus covering the whole circle. It is simpler and more compact than the panorama telescope, but has not the advantage of enabling the layer to keep under cover.

The sight is illustrated in the annexed figure, which shows the prism in front of the object glass turned so as to reflect objects to the left rear. Above the telescope is a casing to protect the prism when turned up out of the way; the telescope, without the prism, can then be traversed so as to command 60° on each side. The prism adds 120° to this on either side, thus completing the circle. On top of the casing is a finder, and below this a drum for setting the angle of sight. The longitudinal level is on top of the drum.

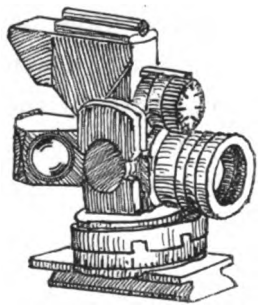

FIG. 8A.

The complete sight is illustrated in Fig. 9, which shows a howitzer sight by the Coventry Ordnance Works. In this case the hood on top of the telescope which takes the prism is omitted, and the telescope is of prismatic construction. There is an arrangement (not visible in the figure) by which the graduated base plate is shifted through 120° when the reflecting

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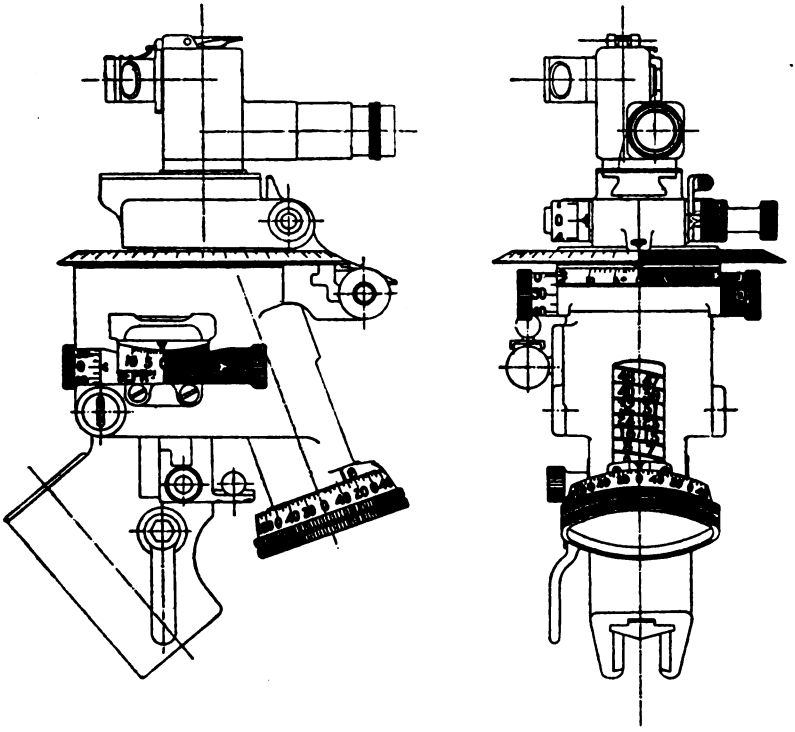
prism is placed in front of the object glass, so that the layer does not have to add or subtract 120° from



Coventry Ordnance Works, 1910.

FIG. 9.—COVENTRY HOWITZER SIGHT.

the reading. Elevation is given by the clinometer level and the spiral scale marked on the drum.

The Clinometer.

This instrument is used when the target is not visible from the gun, to give elevation either for the angle of sight (see *Laying*) or for the range. It consists of a spirit level capable of being inclined at

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any angle. The form used in field guns is the arc clinometer shown in Figs. 9 and 10. The lower part is attached to the sight, while the upper part is capable of sliding on its curved surface so as to incline the level to the desired angle. The degrees of elevation are read on the face of the instrument the minutes on the micrometer heads. In the arc sight already described, the curved sight-bar itself serves as a clinometer, and the level attached to it is inclined as the sight is drawn out of its socket.

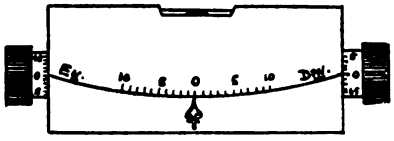

FIG. 10.

Units of Measurement.

The elevation for the range is invariably given in terms of the range—that is, in yards or metres.

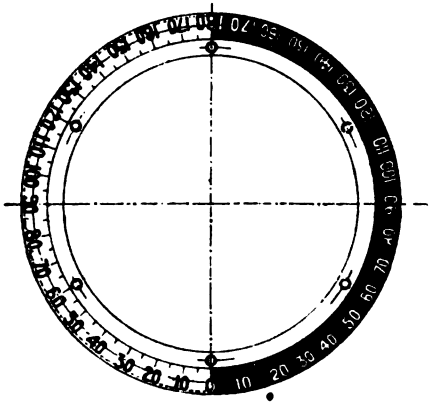

FIG. 11.

The horizontal direction with reference to an aiming point is, in our own service, given in degrees and

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minutes to right and left; in foreign armies it is given either in thousandths of a circle or in some other convenient division of the complete circle. For use in the field, degrees and minutes are far inferior to the decimal system.

The method of graduation used in England is shown in Fig. 11, which represents the base-plate of a dial sight made by the Coventry Ordnance Works.

RECOIL GEAR.

The simplest form of recoil gear is that used in the German guns. It is shown in the annexed sketch.

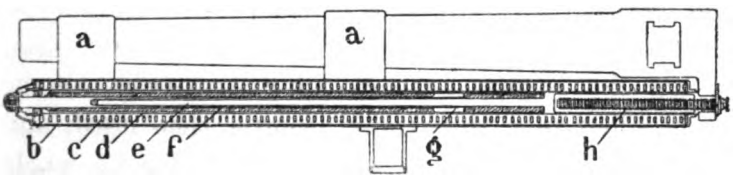

FIG. 12.

The gun is provided with guide-blocks ***a***, which slide on the upper edges of the cradle ***b***. The buffer ***d*** is fixed by the screw ***h*** to the horn at the breech of the gun, while the piston rod ***f*** is fixed to the front of the cradle. A check-buffer plunger ***e*** projects from the base of the buffer, and, when the gun runs up, enters a hollow in the piston ***g*** and piston rod ***f***. The buffer is surrounded by a column of helical springs ***c***, which are compressed between the rear plate of the cradle and the shoulder of the buffer. The buffer is filled with glycerine, denoted by the diagonal shading.

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On firing, the gun and buffer recoil, while the piston remains steady. The glycerine in the buffer has to pass from one side of the piston to the other through grooves or "ports" in the walls of the buffer. The friction of the glycerine in passing through these ports absorbs the recoil energy and brings the gun to a standstill after a recoil of about 4 feet. The depth of the ports at different points is adjusted so as to give a smooth recoil; for the first 2 inches they are enlarged so as to let the glycerine pass freely, in order to give the gun a free recoil till the shell has left the bore. When the gun has come to a standstill, the springs return it to the firing position, the check-buffer preventing it from running up too violently.

In the **English** service equipment (Fig. 1) the gun slides in a ring cradle, shorter than itself, and the gun has guides extending nearly for its whole length. The buffer and springs are over the gun, in a separate casing. Oil, instead of glycerine, is used in the buffer. The springs are telescopic, there being an outer and an inner column; this arrangement halves the compression of each spring-column for a given length of recoil, and renders the springs less liable to be crushed.

Hydropneumatic Recoil Gear.

In modern French equipments the springs are replaced by a separate running-up cylinder, filled with glycerine, in which works a piston attached to the cradle. On recoil the glycerine is forced into a

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reservoir of compressed air; when the gun has come to a standstill the expansion of the air drives back the glycerine and runs the gun up. Compressed air gives a very smooth action, with less vibration than when springs are used. This system has been adopted by the English makers, Armstrong and Vickers-Maxim, in their latest equipments.

The Schneider gear is illustrated in the annexed figure, which shows the buffer and running-up cylinder at bottom and the compressed-air reservoir, consisting of two communicating cylinders, at top. The four cylinders form one forging, which recoils with the gun.

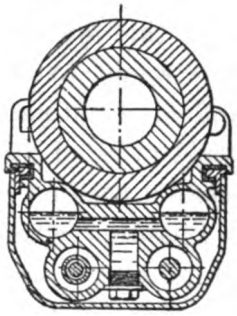

Fig. 13.

The French service gun, made in 1898, has hydro-pneumatic gear, with this difference, that the glycerine is forced direct from the buffer into the compressed-air reservoir. A loose piston in the reservoir is used to prevent the glycerine from mixing with the air, which would produce a froth giving irregular resistances to recoil. This gear works well, but is complicated, and the construction is not likely to be repeated.

Controlled Recoil Gear.

In this system there are no ports in the wall of the buffer, but the glycerine or oil has to pass through ports in the piston itself. These are opened and closed by a circular valve rotated by rifled

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grooves in the buffer. The piston itself can be rotated by gear connected with the elevating wheel, so that as the gun is elevated the opening of the ports is reduced, increasing the resistance and shortening the recoil. This system is used in mountain guns and howitzers in which there is little room available for recoil at high elevations without the breech striking the ground.

Differential Recoil Gear.

In this system the gun is hauled back before the first round to the extreme recoil position, released, and fired automatically by a tripper on the cradle while in rapid forward motion, just as it reaches the forward position. It then recoils to the rear or loading position, where it is held by a catch, and is ready to load and fire again. This reduces the recoil velocity by the amount of the forward velocity imparted to the gun by the springs or compressed air, and so reduces the recoil energy. This enables a more powerful gun to be fired from the same carriage without extra strain upon it, and without causing the carriage to jump. One objection to this system is the inaccuracy caused by the vibration of the carriage during the run-up; another is that if the gun misses fire it will overturn on to its muzzle, unless a special buffer is fitted to absorb the forward energy of the gun. Differential recoil gear is known in England as the "dynamic cradle." It is used in the French 65 mm. mountain gun, and in the Krupp balloon guns on pivot mountings.

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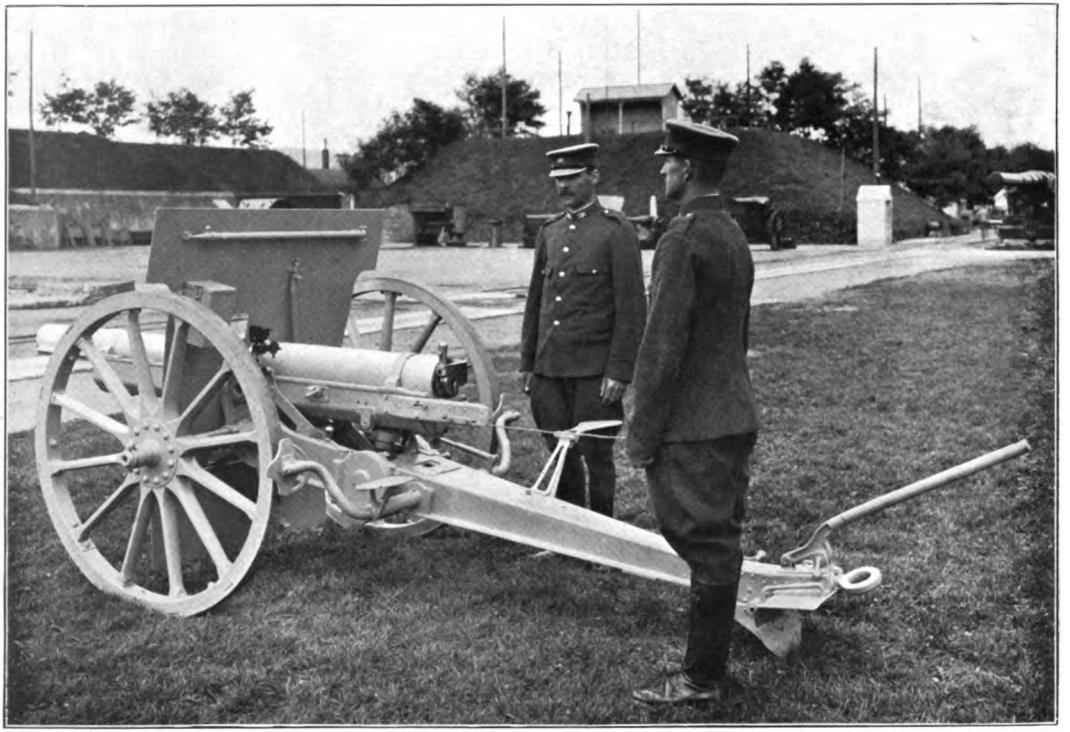

PLATE II.—SCHNEIDER 14·3 PR. DIFFERENTIAL RECOIL FIELD GUN IN FORWARD POSITION, 1910.

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Plate II. represents the Schneider differential recoil field gun. In this equipment the compressed-air gear is assisted by a small buffer, so that the gun can safely be fired from the forward position without winding it back before firing the first round.

Steadiness of Carriage.

The object of all systems of recoil gear is to keep the carriage steady, so that it neither jumps nor recoils when the gun is fired. The pull upon the carriage exerted by the buffer tends to lift the wheels by revolving the carriage about the spade; therefore the weights and dimensions must be so adjusted that the wheels do not lift. Steadiness is promoted by increasing the length of recoil, which enables the resistance in the buffer to be reduced, or by increasing the length of the trail, which enables the weight of the carriage to act with greater leverage. But if the length of the buffer or of the trail be unduly increased, the weight becomes excessive. Another method is to reduce the height of the wheels, which increases the leverage of the weight of the carriage. This expedient reduces the mobility of the gun, especially across country. In a great Continental army, where the masses of troops move slowly, this is of less importance than in our smaller and more mobile forces; moreover, short-service drivers are less expert at driving across country than our own men. Accordingly we find that in most foreign armies the height of the wheel is reduced to

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4 ft. 3 in. to secure greater steadiness of the carriage in firing, whereas we adhere to the 4 ft. 8 in. wheel.

The **traversing gear** has already been described; the modern tendency is to favour the French "axle-traversing" system, in which the gun and carriage are shifted laterally along the axletree, pivoting about the point of the trail. In our 15 pr. converted gun the point of the trail is shifted laterally along the spade, which remains fixed in the ground; this gives a simple carriage, but renders the trail lift heavy.

The **elevating gear** is a screw supporting the traversing plate, upon which the breech end of the cradle traverses. To avoid the downward projection of the screw below the trail, where it would be liable to damage in crossing obstacles, the screw is usually made telescopic.

The **trail** is a tapering steel box or girder, or a steel tube as in the 18 pr.; at the point of it is fixed the **spade** which holds the carriage from recoiling. In some equipments the spade folds upwards for firing on rocky ground, leaving a small fixed **spur** to hold the carriage. The **axletree** is a steel tube tapered at the ends; in some carriages a cranked axletree, bent downwards in the middle, is used to keep the weight low. **Axletree seats** are provided in some equipments, but as the modern Q.F. gun is always accompanied by a wagon seated for six men, these are no longer considered necessary. The **wheels** are of wood, with steel tire and nave; steel wheels have been tried, but

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are less elastic than wood, and unduly increase the vibration and wear of the carriage in travelling.

The **shield** is a most important part of the equipment, and has made a great difference in the tactical employment of the Q.F. gun. It is of hard steel plate, designed to keep out shrapnel bullets at all ranges, and rifle bullets at ranges exceeding 500 yards. If made thick enough to keep out modern pointed bullets fired from distances under 50 yards, the shield has to be made of plate weighing 10 lb. per square foot, which makes the carriage undesirably heavy. The lower portion of the shield folds upwards for travelling; the upper portion is curved backwards, or, in some equipments, folds down horizontally to give overhead cover. With axle-traversing guns, the shield, which traverses with the carriage, does not extend as far as the wheels, and leaves a gap on each side; in recent equipments these gaps are filled by hinged flaps.

THE LIMBER.

The limber of a field gun is a steel ammunition box on two wheels. It has a splinter-bar and pole, and a limber hook, to which the gun is limbered up. In the latest equipments the limber hook, and the loops on the splinter-bar to which the swingletrees are attached, are fitted with springs to ease the draught. The limber box affords a seat for two or for three gunners; the door opens to the rear. It is of either the **cellular** or **honeycomb** construction. In the former the box is divided by

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steel partitions into compartments, each taking a basket holding three or four rounds of fixed ammunition. In the latter each round is in a separate tube of brass or basket work.

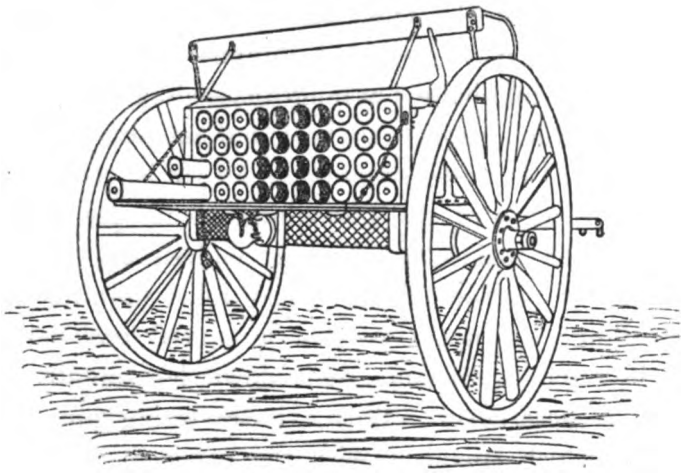

FIG. 14.

The figure represents a gun limber by the Coventry Ordnance Works, with spring limber hook of the keyless pattern, the trail eye being held by a catch when dropped into the limber hook.

THE AMMUNITION WAGON.

This consists of a limber, usually similar to the gun limber, and a wagon body. The construction of the latter varies according to the method of use; in our own service the complete wagon is placed beside the gun in action, in foreign equipments the wagon body is unlimbered, and either supported by a prop or tipped so as to bring the lid of the

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box vertical. In the latter type the lid is in two halves opening outwards, forming side shields for the men preparing ammunition. With the cellular construction this necessitates carrying the fixed ammunition vertically when travelling, which is con-

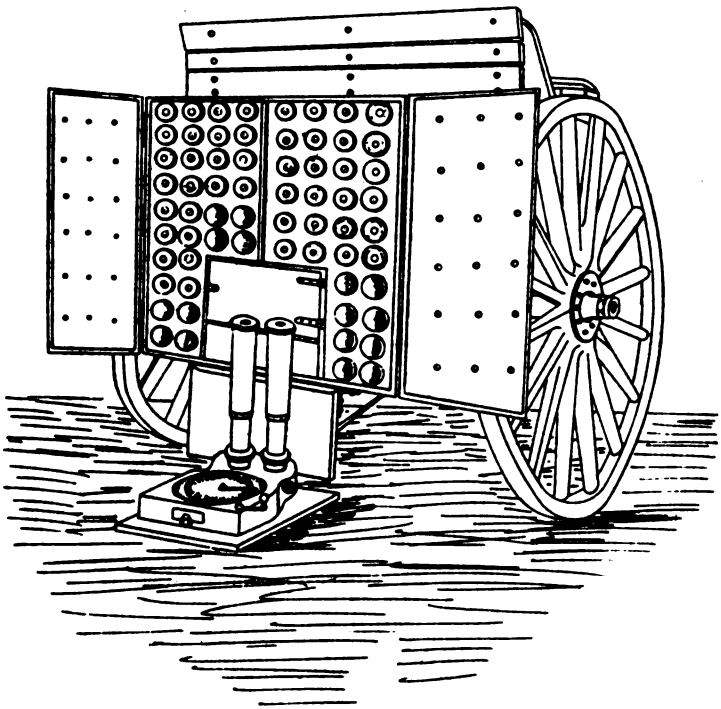

FIG. 15.

sidered to be bad for the fuzes. With non-tipping wagons the rear door hangs down to the ground, forming a shield.

The illustration shows a wagon of the tipping pattern made by the Coventry Ordnance Works. The fuze-setting machine, with two shells, is seen on the ground behind it.

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WEIGHTS AND DIMENSIONS OF FIELD GUNS.

These vary in different countries, as will be seen from the following table:

TABLE OF FIELD GUNS.

	England.	France.	Germany.
Weight of shell - - - - - lb.	18·5	16	15
Muzzle velocity - - - - - f.s.	1610	1740	1525
Calibre - - - - - - - inches	3·3	2·95	3·03
Weight of gun in action - - - cwt.	24·75	22·4	18·6
Rounds in limber - - - - - -	24	24	36
Weight of gun and limber - - - cwt.	40	37	34·5
Men carried - - - - - - -	2	3	5
Weight of gun behind team with gunners and kits - - - - - - cwt.	43	41·5	42
Weight of ammunition wagon, packed, cwt.	36·75	38·5	35
Rounds in wagon - - - - - -	76	96	88
Men carried on wagon - - - - -	4	5	5
Weight of wagon behind team with gunners and kits - - - - - - cwt.	42·75	46	42·5

In estimating the mobility of an equipment on the march, the weight of the gunners is not taken into account, as these invariably dismount for hills and when the road is heavy, and only mount when the road is hard and level, as their weight then makes little difference.

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CHAPTER II.

THE Q.F. FIELD HOWITZER.

With a field gun, the object is to get a flat trajectory giving a deep zone of shrapnel effect. With a field howitzer, the object is to make the bullets strike downwards as nearly vertically as possible, in order to reach men behind gun-shields or steep cover. Accordingly the howitzer is a gun mounted so as to fire at angles up to 45 degrees.

A field howitzer also fires high-explosive shell for destroying buildings and such overhead cover as is likely to be met with in field works.

The weight of the shell is limited by that of the equipment, which should be no less mobile than a field gun. It is usually from 35 to 40 pounds.

With a velocity of 1000 feet per second, a howitzer shell, at full elevation, ranges about 6000 yards, and accordingly this velocity is commonly accepted as sufficient. For such a low velocity a long gun is not required, and the usual length of a howitzer is from 12 to 15 calibres. To get good shooting, a howitzer shell requires to be rather shorter and more stumpy than that of a field-gun, and the calibre is accordingly between 4·2 and 4·7 inches.

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Besides its use for high-angle fire, a field howitzer must also be capable of employment as a field gun, firing shrapnel at angles of elevation under 15 degrees, whenever required; therefore the carriage must be so designed as to be steady when the howitzer is fired point-blank. With the severe recoil caused by firing a heavy shell this condition is not easy to realize; and some equipments are therefore designed so that the howitzer is steady when fired point-blank only with the second highest charge, although the full charge can safely be fired point-blank on emergency.

Construction.

The construction of the gun and carriage is the same as in a field gun, with one important exception. The ordinary system of recoil gear is not applicable, because the howitzer, when elevated to 45°, would strike the ground in recoiling. A long recoil is necessary in order to keep the carriage steady when the howitzer is fired without elevation, and the recoil has therefore to be shortened at high elevations, or else the cradle trunnions have to be so placed as to give extra room for recoil. The first of these systems is called **controlled recoil**, the second **rear trunnions**.

Controlled Recoil.

This has already been described under *Recoil Gear*. As the howitzer is elevated the ports in the piston are gradually closed so as to increase the buffer-resistance and shorten the recoil. This system

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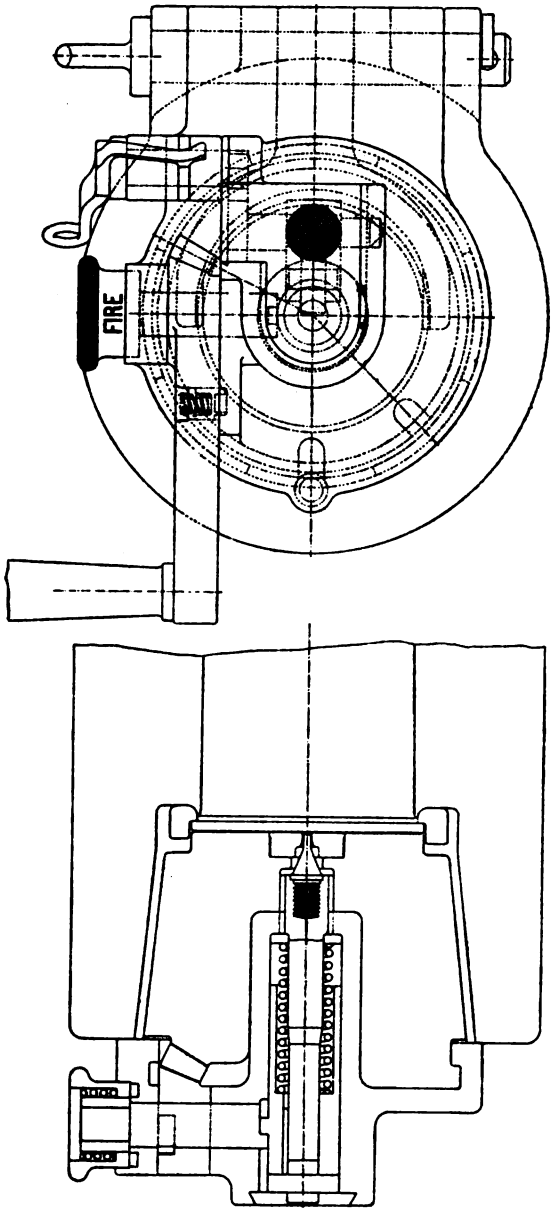

FIG. 15 A.—HOWITZER INTERRUPTED SCREW BREECH ACTION.

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is used in several equipments, and answers well. The objections to it are the complication of the parts and their liability to wear.

Rear Trunnions.

The cradle trunnions are set under the breech, or even further to the rear. Thus when the howitzer is elevated the breech is not brought any closer to the ground, or is even further from it, leaving room for long recoil. The forward preponderance of the howitzer is supported by a spring under the chase. The objections urged against this system are that the spring gives on discharge, causing the muzzle to dip, and that the rear trunnions do not hold the cradle and howitzer as steady as central trunnions. Moreover, when fully elevated, the weight of the howitzer is above the level of the wheels, causing unsteadiness when it is fired on uneven ground.

A combination of rear trunnions and controlled recoil is sometimes used. **Differential recoil** (see *Recoil Gear*) would enable the recoil to be shortened, and get over the difficulty of the deficient space for recoil, but this system has not yet been sufficiently perfected to use in field howitzers.

The howitzer **limber** is similar to that of a field gun, but is usually made lighter, containing fewer rounds, so as to get a heavier howitzer with the same weight behind the team.

Plate III. represents the **Krupp** 4·7 in. field howitzer, as adopted by Switzerland, Italy, and other States. It fires a shell weighing 46 lb. with M.V. 985 f.s.,

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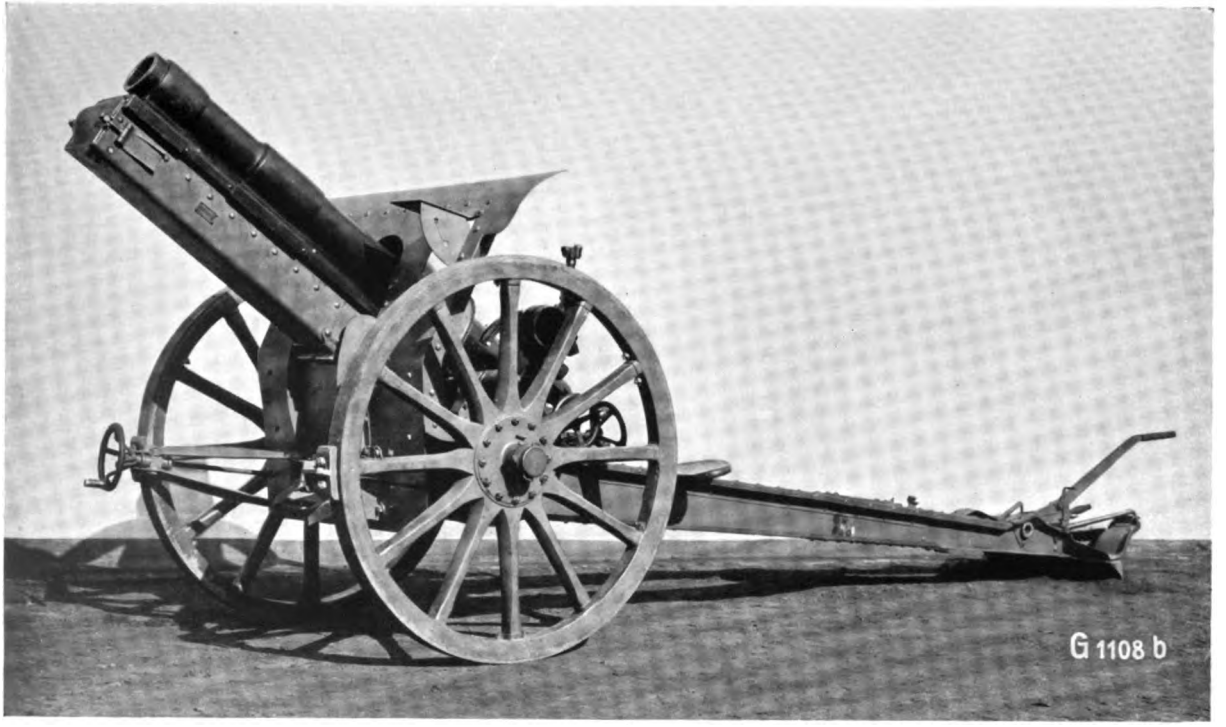

PLATE III.—KRUPP 4·7 IN. FIELD HOWITZER, 1910.

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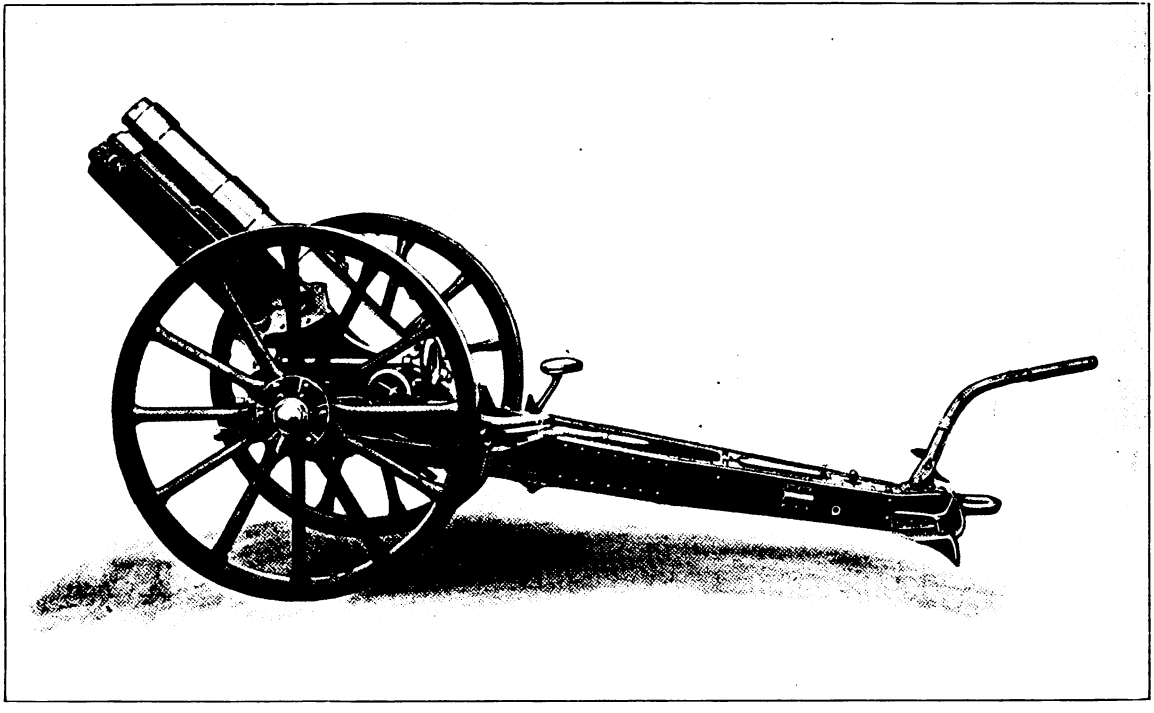

PLATE IV.—COVENTRY ORDNANCE WORKS 4·625 IN. FIELD HOWITZER, 1910.

(*Shield removed.*)

To face p. 39.

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and ranges 7400 yards. The shrapnel contains 800 heavy bullets, 35 to the pound, and the high-explosive shell contains 4½ lb. of trinitrotoluol (see *Ammunition*). The howitzer has rear trunnions and constant recoil of 48 in.; the wheels are 4 ft 3 in. in diameter, and the weight in action is 26 cwt. The panorama sight may be seen over the wheel.

The **Coventry Ordnance Works** 115 mm. (4·625 in.) field howitzer is shown in Plate IV. This howitzer is of unusual length, being 16 calibres long, and the remarkably good shooting obtained with it may be ascribed partly to this cause and partly to the excellence of the ammunition. The makers claim that this howitzer is far more accurate than any field howitzer yet produced in France or Germany. It fires a shell weighing 37½ lb. with M.V. of 1000 f.s. It has central trunnions and controlled recoil, so regulated that the breech does not touch the ground when fired at full elevation. It is sighted with panorama sights and has a large hooded shield. On 4 ft. 8 in. wheels, the weight in action is 24½ cwt.

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CHAPTER III.

HEAVY FIELD GUNS AND HOWITZERS.

THE Q.F. HEAVY FIELD GUN.

THIS is a long-range gun, capable of throwing a 60 lb. shell to a distance of over 10,000 yards. The construction is much the same as in field guns, but the recoil gear is generally duplicated, one set being on each side of the gun. A further peculiarity is that the gun is capable of being shifted to a **travelling position** in order to divide the weight between the gun and limber wheels. This is effected by hauling the gun, and in some equipments the upper carriage, back along the trail.

A good specimen of the modern heavy gun is the Krupp equipment illustrated in Plate V. This is a 4·2 in. gun throwing a 40 lb. shell with M.V. 1970 f.s., ranging 12,500 yards at 25° elevation. The weight in action is 3 tons, and the weight behind the team 3½ tons. No ammunition is carried in the limber. The breech action is the interrupted screw, and the gun is sighted with telescopic and panorama sights. The recoil gear is a single buffer and springs in the cradle under the gun. The shrapnel contains 630

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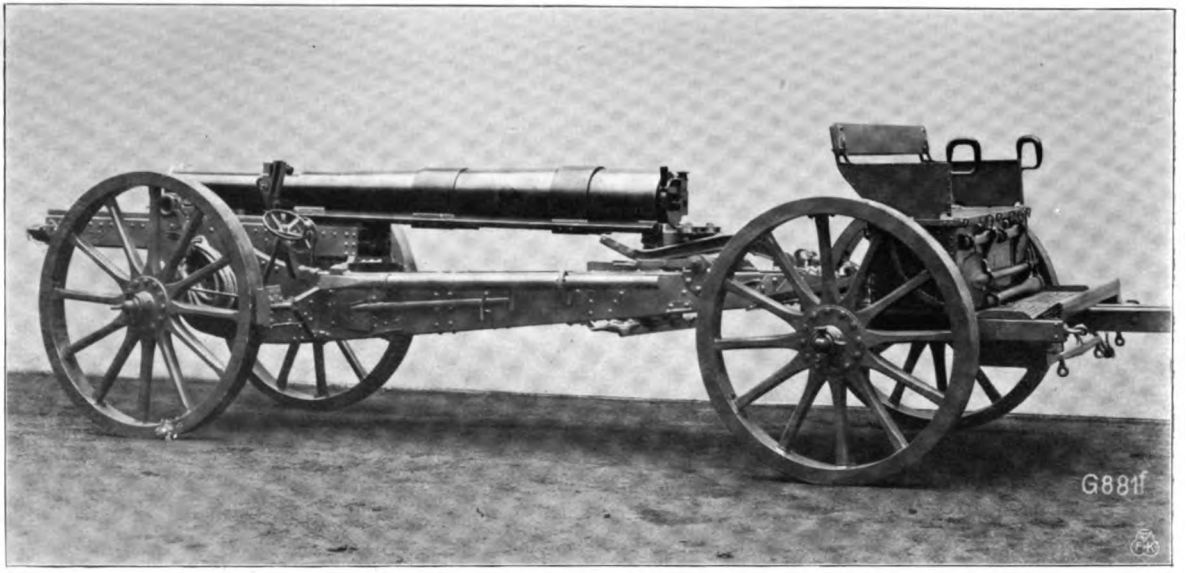

PLATE V.—KRUPP 4·2 IN. HEAVY FIELD GUN.

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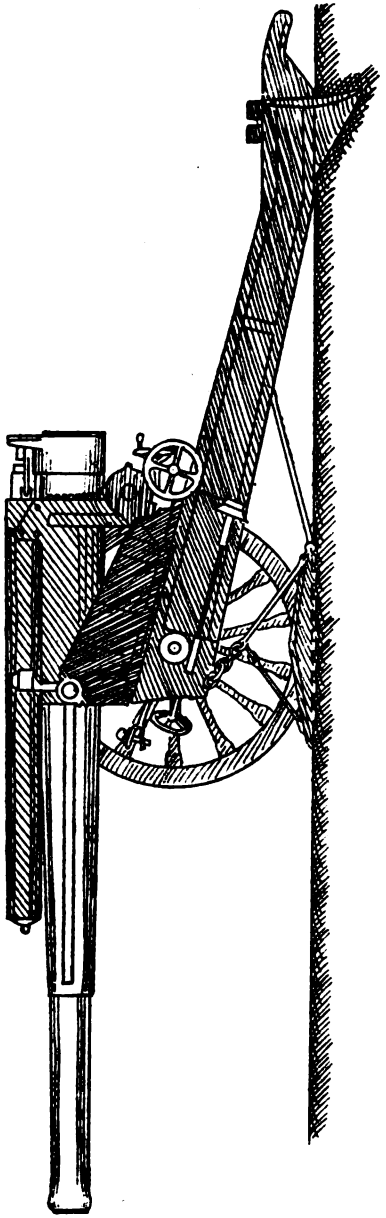

FIG. 16.—60 PR. HEAVY FIELD GUN.

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bullets of 35 to the pound, and the high-explosive shell contains 1·8 lb. of trinitrotoluol.

Our own service heavy field gun is a 60 pr., and is considerably more powerful than the above.

The 60 pr. is illustrated in Fig. 16. It has a double set of recoil gear over the gun, which is mounted on a top carriage and can be shifted to a travelling position as in Fig. 44, so as to equalize the weight on the gun and limber wheels. The shrapnel contains nearly 1000 heavy bullets (35 to the pound), and ranges 10,000 yards at 20° elevation. The shooting of the gun is extraordinarily good, and it will hit a hostile shielded gun with high-explosive shell almost at every shot at medium ranges. The weight behind the team is about 5 tons.

An Armstrong 60 pr. is illustrated in Fig. 17.

This gun has a ring cradle, with the recoil gear under it. It is capable of being shifted to a

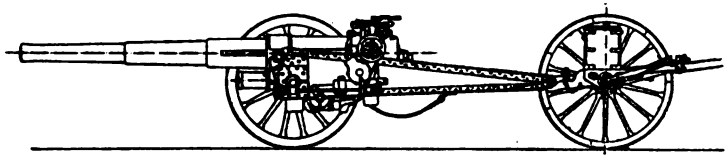

Fig. 17.

travelling position for the line of march. The muzzle velocity is 2150 f.s., and the weight behind the team with shield is 4½ tons. This gun is also a remarkably accurate weapon.

Generally speaking, it would appear sound, for the purposes of heavy field artillery, to use the heaviest gun that can be transported in the field. At present

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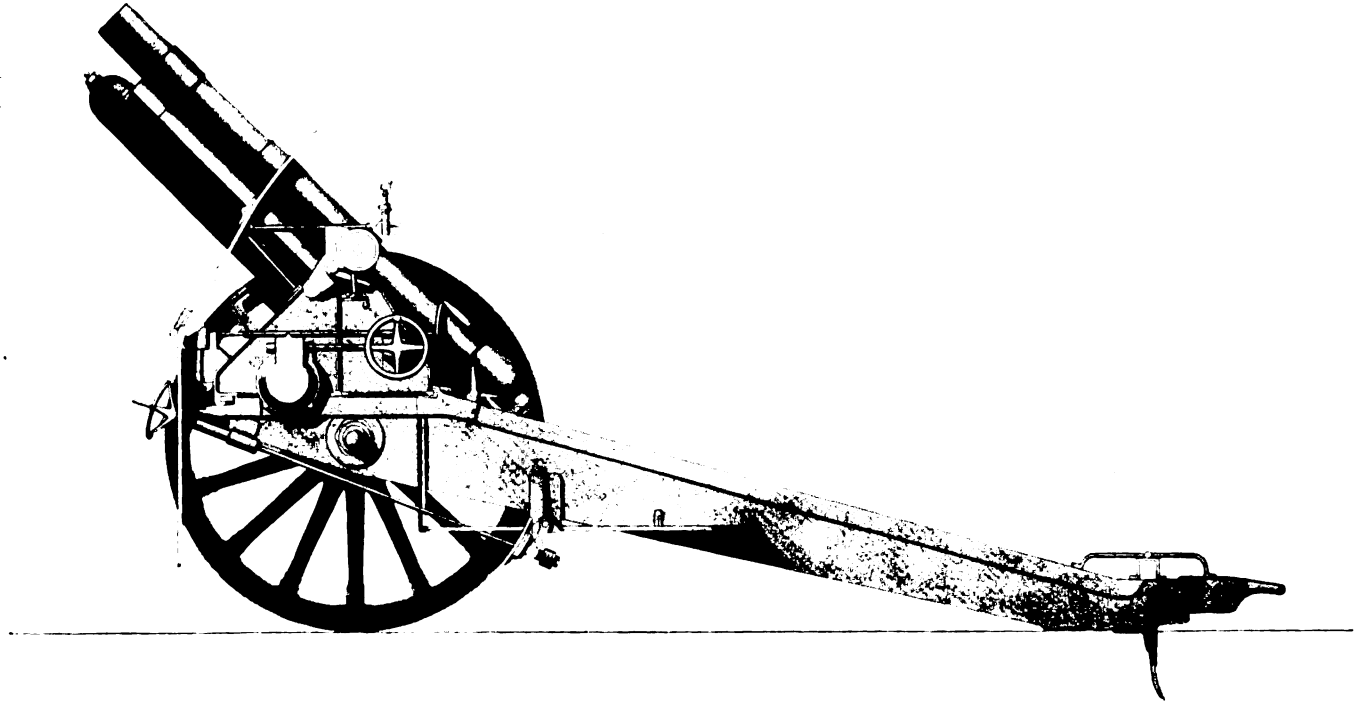

PLATE VI.—VICKERS MAXIM 6 IN. HEAVY FIELD HOWITZER, 1910.

To face p. 43.

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a team of 8 heavy horses is the largest that it is considered desirable to employ, and this fixes the total weight at about 5 tons. It is possible that with improvements in motor traction the weight of the equipment will increase. The difficulty as to the sinking of the wheels when moving off the road can be overcome by the use of **girdles**, which are linked steel plates fixed round the tire, but the weight of the gun and tractor will still be limited by the strength of the ordinary bridges of the country.

THE Q.F. HEAVY FIELD HOWITZER.

Instead of using heavy field guns, most foreign nations prefer heavy howitzers, capable of throwing a much heavier shell to the same range with the same weight of equipment. In view of the difficulty of observation, and consequently of accurate ranging, at long distances, it is an open question whether a 90 lb. howitzer shell with a steep angle of descent is superior to a 60 lb. gun shell with a very flat trajectory.

The **Vickers Maxim** 6 in. heavy field howitzer is illustrated in Plate VI. It fires a 90 lb. H.E. shell, or shrapnel containing about 1000 extra heavy bullets (24 to the pound). The muzzle velocity is 1285 f.s., and the range over 12,000 yards. Space for recoil is obtained by using wheels 6 feet in diameter, which is a very suitable size for a heavy howitzer. The large wheels render the draught easier, and are not so liable to sink in soft ground

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as the small wheels used in foreign equipments. The weight behind the team is 4 tons, which enables it to be drawn by a team of six heavy horses. This is a far more powerful weapon than that possessed by any foreign Power.

The French **Rimailho** field howitzer is intended to be capable of moving short distances at a trot. The calibre is 6·1 in., and the shrapnel weighs 88 lb., ranging 8000 yards. The howitzer has rear trunnions, allowing a recoil of 5 feet. It has semi-automatic eccentric screw breech mechanism, and traverses on the axletree. The peculiarity of the equipment is

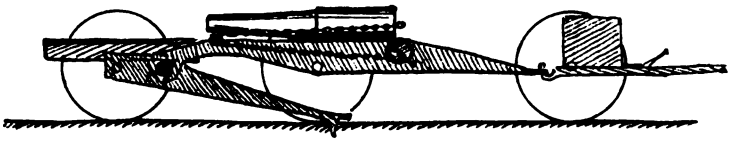

FIG. 18.

that, although it weighs 64 cwt. in action, it is divisible into loads not exceeding 48 cwt. for travelling. This is accomplished by carrying the howitzer itself on a separate two-wheeled transporting carriage with a limber of its own.

To limber up, the transporting carriage is brought up behind the firing carriage and backed over the trail till the end of the ways rests on the cradle trunnions, as in the annexed sketch. The cradle is then depressed, and the carriage traversed, till the cradle is in line with the ways; the howitzer is hauled back on to the ways by the winch and chain. To bring the howitzer into action the process is reversed, the chain being passed round a pulley, as

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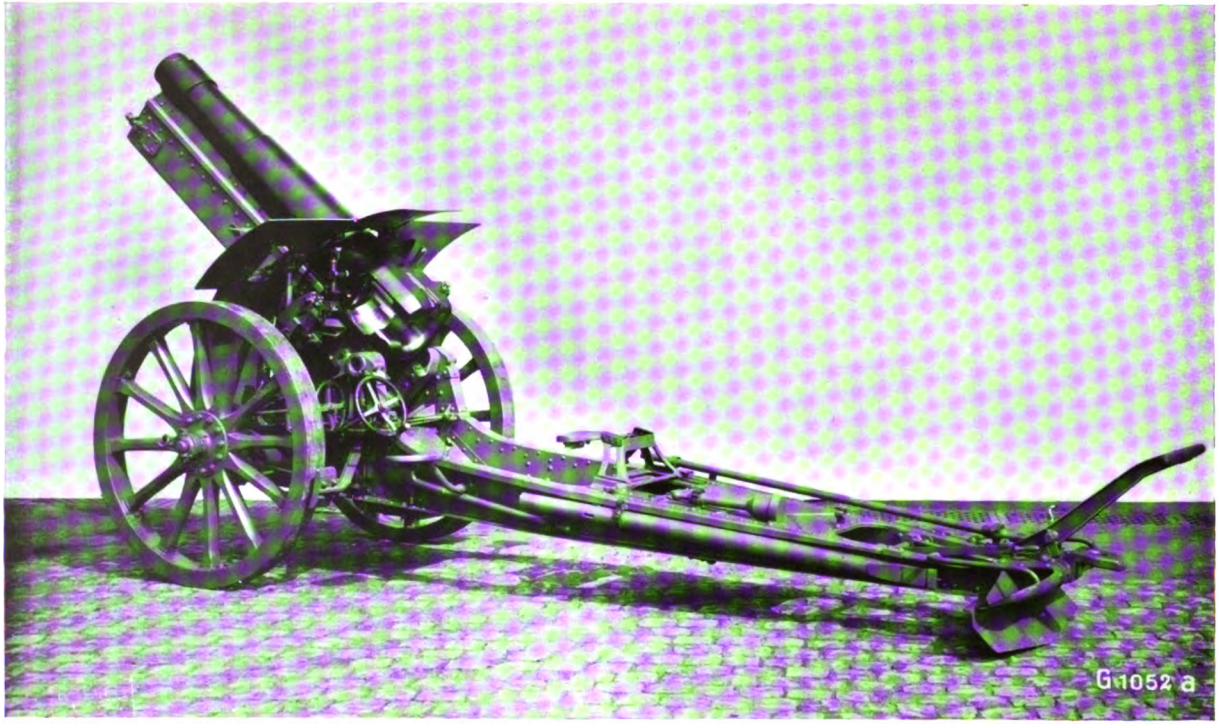

PLATE VII.—KRUPP 6 IN. HEAVY FIELD HOWITZER.

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shown in the sketch. It is stated that the shift can be completed in two minutes.

The German 5·9 in. heavy howitzer is a lighter weapon, weighing only 44 cwt. in action. It fires a 95 lb. shell with M.V. 910 f.s., and ranges about 7000 yards. It is of the Krupp construction, with rear trunnions, pivoted upper carriage, and wedge breech action. It is capable of no less than 65° elevation, giving an angle of descent of 70° at medium ranges. But experience with similar weapons shows that high-angle fire at such elevations is very inaccurate, even on a still day.

The Krupp heavy field howitzer is illustrated in Plate VII. It is of 6 in. calibre, and fires a 90 lb. shell, ranging 8000 yards. It has rear trunnions, and weighs 43 cwt. in action, or 2½ tons behind the team.

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CHAPTER IV.

HORSE AND MOUNTAIN ARTILLERY.

THE Q.F. HORSE ARTILLERY GUN.

THIS is a field gun sufficiently mobile to accompany cavalry. It has no seats for the detachment, and the men are all mounted. Special horse artillery equipments, such as our own, are made lighter than gun equipments, the weight behind the team being not more than 32 cwt. But this entails a lighter gun and lighter ammunition. In the great Continental armies the authorities are reluctant to increase the difficulty of ammunition supply on the battlefield by adding to the number of varieties of ammunition, and accordingly in these armies no special Q.F. horse artillery guns have been introduced, and the H.A. guns are merely field guns with the axletree seats removed, and sometimes with special light limbers.

Our own 13 pr. is a reduced copy of the 18 pr. equipment. It fires a 13·5 lb. shell with M.V. of 1660 f.s., and weighs 19·5 cwt. in action.

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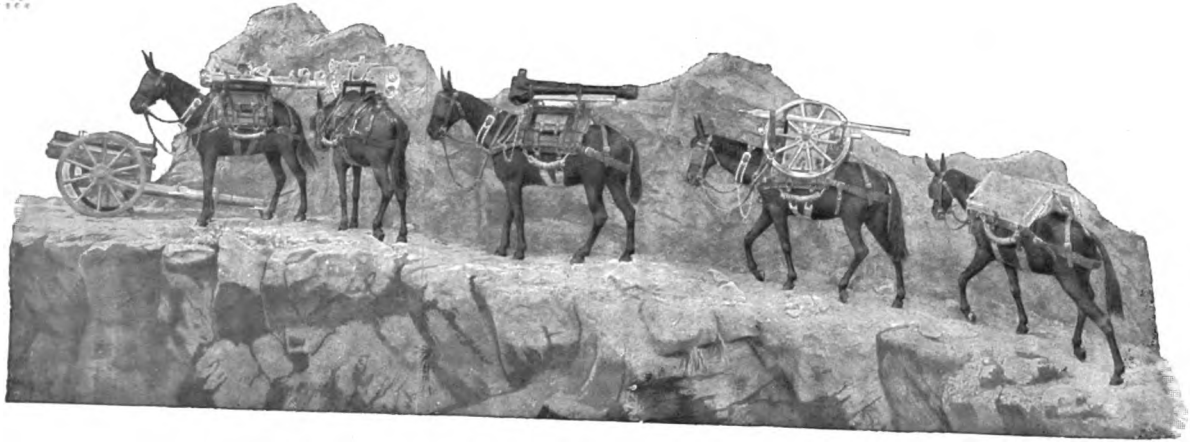

PLATE VIII.—MOUNTAIN ARTILLERY WITH EHRHARDT GUNS.

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THE Q.F. MOUNTAIN GUN.

Power.

A mountain gun is a field gun designed for use on ground where wheeled carriages cannot travel. Tactically, it should be no less powerful than the field gun, but in practice the limitations of pack transport stand in the way. Although the equipment may be divided into four, five, or more mule-loads, the weight and length of each load are limited. A mule carries either a top load, such as the gun or trail, or a side load, such as a pair of ammunition boxes. Even for specially-selected gun mules, the top load should not exceed 250 lb., besides the 65 lb. of saddle and equipment. The length of the load should not exceed 4 ft. 6 in. A gun weighing 255 lb. cannot be made sufficiently powerful for modern requirements, therefore a jointed gun carried by two mules is used. Our old "screw gun" was divided half-way down the bore, the two halves of the gun being held together by the trunnion ring; but modern guns are divided behind the base of the cartridge, the breech-ring and breech-block being carried on another mule. The Russian Schneider-Danglis gun, made on this pattern, is a 14·3 pr. with M.V. 1235 f.s., the heaviest top load being 245 lb. net. The heaviest side load is 275 lb. net.

Plate VIII. represents a mountain gun with carriage and ammunition ready to come into action, and a second gun ready to fire. The plate shows an early pattern of Ehrhardt gun; the latest pattern

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is shielded and has controlled recoil gear, and the long pole carried with the wheel load is jointed.

A mountain gun has a pole or pair of light shafts which can be fixed to the trail, so that it can travel on its own wheels when the ground is good.

Construction.

The general construction of gun, carriage and ammunition is the same as in a field gun. The gun is not permanently connected to the recoil gear, but is dropped into recessed blocks on a **sleigh** when put together for action, and is secured by a key. The sleigh forms the cover of the cradle, and slides on the cradle guides in recoiling. The trail is made folding, and the point, with the spade, is removable to enable the gun to be used in cramped positions. In this case a fixed spur on the second joint of the trail takes the place of the spade.

Mountain guns fire fixed ammunition, including shrapnel, high-explosive, and ring shell. The figure opposite shows the shrapnel of the **Vickers Maxim** mountain gun, and a complete round of fixed ammunition.

A mountain gun is usually capable of 30° of elevation. To afford room for recoil, the axletree is cranked, the crank being normally downwards. When extra elevation is required the crank is turned upwards and held in position by stays attached to the trail; this raises the axis of the gun to about 40 inches from the ground, and gives plenty of room under the carriage.

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In view of the uneven platforms on which it has to be used, a mountain gun is always fitted with reciprocating sights (see *Sights*) to allow for difference of level of wheels.

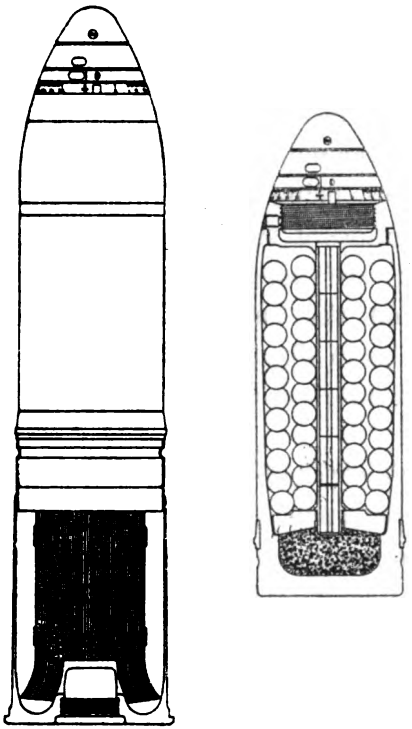

Fig. 19.

The **shield** of a mountain gun, if it only filled up the space between the wheels, would be too small for protection; it is therefore made to extend beyond the wheels on either side. A separate shield is usually placed beside the gun to protect the ammunition numbers.

A mountain battery has no **limbers** or **wagons**. It

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is followed by an **ammunition column**, which, according to the nature of the country, may consist of pack transport, light narrow-gauge wagons, or two-wheeled carts.

The **Vickers Maxim** mountain gun is shown in Plate IX.; the latest pattern has a larger shield. This gun is a 12½ pr. forming four mule loads. The trail is in three pieces; in cramped ground it can be shortened by removing the rear piece, or the two rear pieces, the gun being then held by a fixed spur on the front section of the trail. The breech piece and breech-block are removed when the gun is dismounted, and the chase forms one mule load or carrier load, as in Fig. 21. The gun can be unloaded and brought into action in less than one minute.

Special Constructions.

The Krupp 1909 mountain gun (see *Table*) has the semi-automatic breech mechanism and differential recoil gear already described. The latter gear reduces the recoil so that a 14·3 pr. shell can be fired from a gun in one piece. The semi-automatic action enables one man at the gun to be dispensed with, which is important in view of the small amount of cover afforded by the shield of a mountain gun.

In the Russian Schneider-Danglis gun the breech ring is prolonged forward into a loose jacket, which increases the recoiling weight and enables unusually high power to be obtained.

The French service mountain gun has differential recoil gear, assisted by a small buffer, and has also

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PLATE IX.—VICKERS MAXIM MOUNTAIN GUN, 1910.

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the semi-automatic eccentric screw breech mechanism. The calibre is 2·6 inches, shell 9·8 lb., and M.V. 1320 f.s. This gun is hardly powerful enough for modern requirements.

The Forges de Châtillon have brought out Col. Deport's mountain gun, which has purely differential recoil without any buffer. Owing to the short recoil it is capable of firing up to 45° elevation. Although a 14·3 pr., this gun forms only three mule loads without shield. It has the semi-automatic breech mechanism with eccentric screw.

WEIGHTS AND DIMENSIONS OF MOUNTAIN GUNS.

	Russia, 1909 (Schneider)	Krupp, 1909.	Vickers Maxim, 1908.
Calibre - - - - - inches	2·95	2·95	2·95
Weight of shell - - - - lb.	14·3	14·3	12·5
Muzzle velocity - - - - f.s.	1235	1015	1150
Gun in one piece or two - - -	Two	One	Two
Breech action - - - - -	Screw	Wedge	Screw
Ordinary or semi-automatic breech -	O.	S.A.	O.
Ordinary or differential recoil - -	O.	Diff.	O.
Greatest elevation - - degrees	30	28	20
Diameter of wheels - - inches	35·5	32	36
Weight in action, with shield - cwt.	10·4	9·9	10
Heaviest load, with saddle - - lb.	300	315	296
Number of loads, without shields -	5	5[1]	4

[1] Including 8 mm. gun-shield.

THE Q.F. MOUNTAIN HOWITZER.

For dealing with entrenchments in mountain country, such as would be met with in a campaign in

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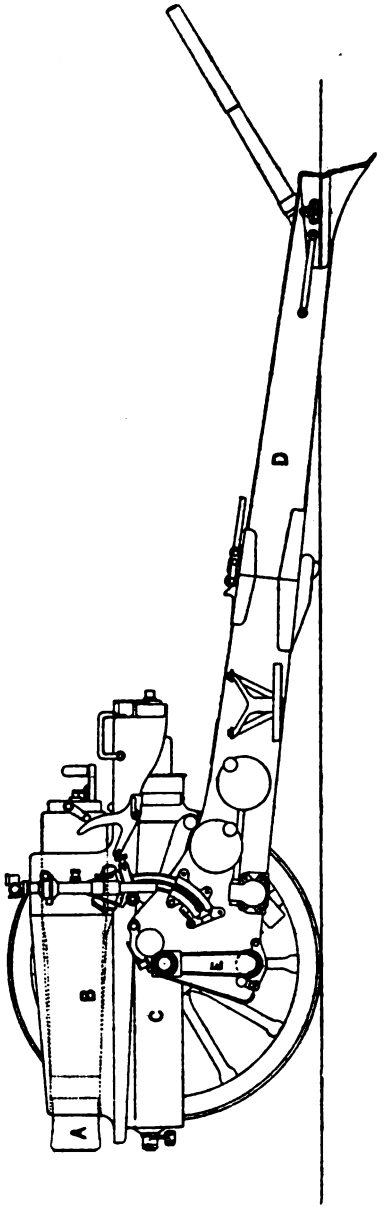

Fig. 20.—Armstrong Mountain Howitzer, 1910.

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the Alps or the Balkans, a mountain gun throwing a heavy shell is required. The mountain howitzer has been developed to meet the demand.

A good specimen is the Armstrong mountain howitzer shown in Fig. 20.

The howitzer A fits into the casing B, which is extended to form a sleigh sliding on the upper surface of the cradle C. The cradle is pivoted on horizontal trunnions on the jointed trail D. The trail is supported by the revolving cranked axletree E; the figure shows the carriage in the low position, but to fire at high elevations the crank is turned upwards, raising the howitzer above the top of the wheels, so as to afford plenty of room for recoil. The recoil gear consists of a buffer and springs of the ordinary type, contained in the cradle. The howitzer fires a 20 lb. shell with muzzle velocity of 950 f.s.

The shield forms an extra half-load; it is not shown in the figure.

The Krupp mountain howitzer has rear trunnions; it fires a 27 lb. shell with M.V. 820 f.s. It weighs 21 cwt. in action, and forms 12 mule loads with shield.

Q.F. PORTABLE GUNS.

These are used in swampy and intersected countries where the streams can only be crossed by foot bridges or canoes. There is very little difference between a mountain equipment and a portable equipment; the limitations of weight are practically the same, since four bearers with a pole carry about the same load

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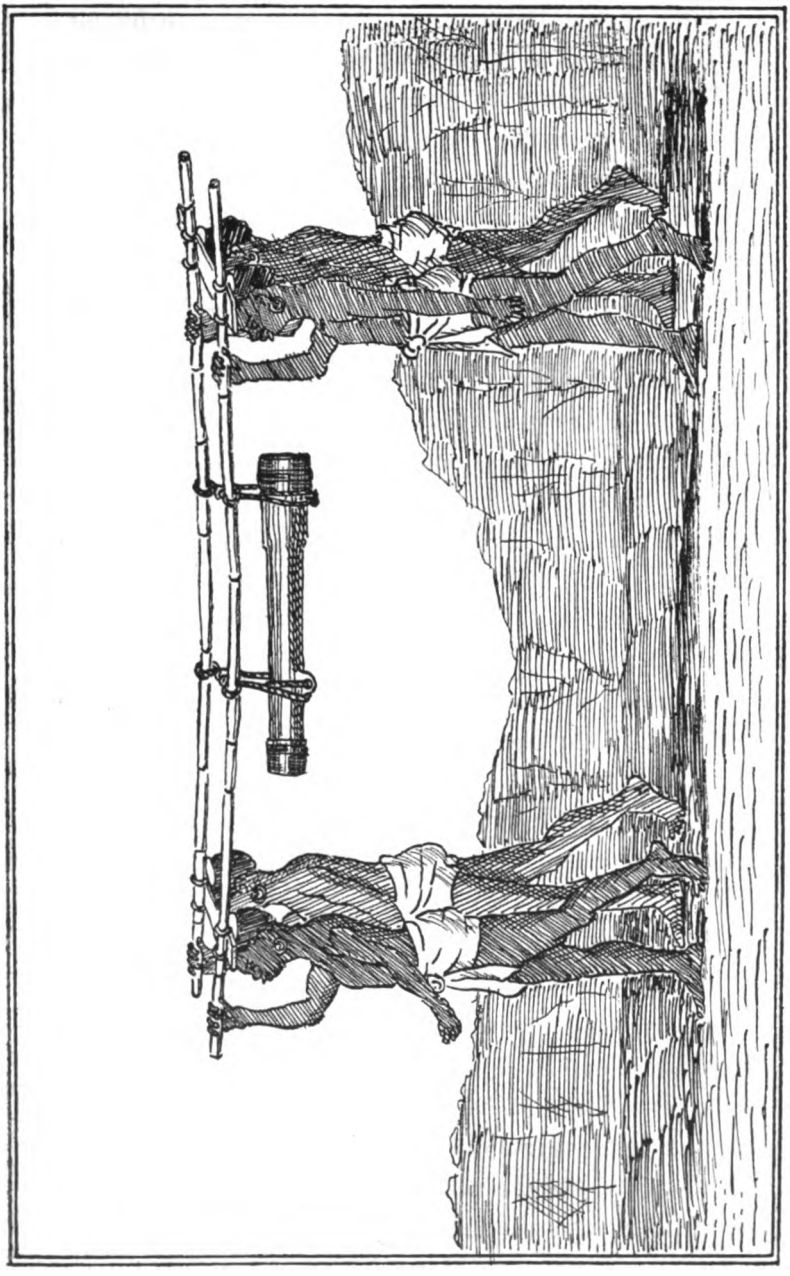

From a Photograph.

FIG. 21.—CARRIERS WITH VICKERS MAXIM MOUNTAIN GUN.

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as a mule. In fact most mountain guns could be used as portable guns if required. A portable gun is exposed to rough and unskilled handling, and the gear should be as simple and as well protected as possible. In addition to ordinary ammunition, these guns fire star shell and incendiary shell.

Fig. 21 represents the gun load (without the breech-ring) of a Vickers Maxim mountain gun as arranged for bearer transport on the West Coast of Africa. For narrow tracks a second pair of cross-bars is fitted, and the men then walk in single file. But the load is a comparatively light one, and can be carried for a short distance by two men.

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CHAPTER V.

THE Q.F. BALLOON GUN.

BALLOON guns comprise both guns for the armament of balloons and guns for shooting at balloons from the ground. The former type may be designated the **aero-naval** gun. Apparatus for dropping shell from balloons will be considered separately.

THE AERO-NAVAL GUN.

So far as known, no gun for the armament of one dirigible against another has yet been practically tried. The design of such a gun must therefore be a matter of theory, which, being based on the imperfect data at our command, may or may not be confirmed by practice.

To arrive at the design of the gun, it is necessary to consider briefly the tactics of fighting dirigibles. Since ramming or boarding would mean the destruction of both, they must fight with projectiles, whether of the rocket type, or shell fired from a gun, or shell dropped from above. If one dirigible can get vertically over another dirigible of the present type, she will have her at her mercy, and we may conceive a

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battle in which the desperate struggle for the upper place will induce the combatants to throw overboard their stores and even, as a last resource, their engines. But before one airship can get above the other she must approach at such an angle as will expose her to artillery fire. It is only when masked by the enemy's gas-bag (or by clouds or darkness) that the upper ship will be safe.

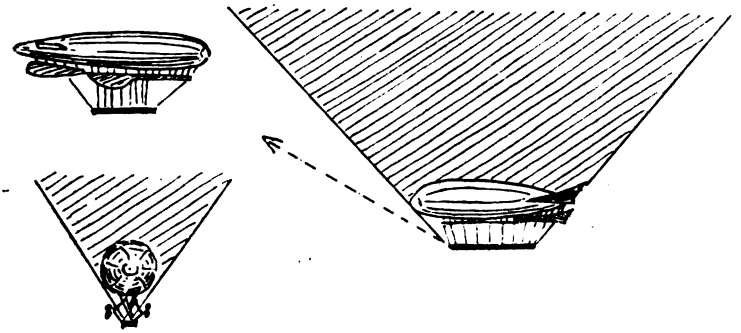

Fig. 22.

Thus in Fig. 22 the upper ship is not safe till she enters the shaded space. Until this happens she will be exposed to fire from the lower ship, and, unless she can rise out of range of the lower ship's guns, both will be on equal terms. Therefore the ship which can hit the other at the longest distance must win.

If both ships have reached the limit of ascent, and meet on the same level, the same holds good.

Now the power of hitting one airship from another at a distance depends first on the range of the gun, a matter as to which there is little difficulty; and

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secondly on the means of laying that gun, which is a very difficult matter indeed.

The problem of hitting one moving body from another moving body with a projectile travelling through a resisting medium is one that cannot adequately be discussed in a book like the present one. It is impossible even to indicate the method of solution of the three-dimensional curves involved without recourse to higher mathematics. However, it may be said that the information required in order to lay the gun is as follows:

1. Speed and course of firing ship.
2. Range of target ship (predicted).
3. Rate and direction of variation of angle of target ship with course of firing ship.
4. Hence, speed and course of target ship.
5. Trajectory of projectile (time and space).
6. Density of air.
7. Angle of sight.

It is assumed that both airships are sailing through a body of air in uniform motion. The speeds refer to motion through the air; the speed with reference to the earth is here immaterial.

Of these data, (1) is given by the engine revolutions or the log, (2) is obtained with a one-man rangefinder (see *Rangefinders*) with a 5-foot base; (3) and (7) by a theodolite with clock attachment; (4) is determined with an instrument similar to the plotter, on which the foregoing data are set; (5) from the range table; and (6) from the barometer.

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In our own and foreign navies a somewhat elaborate instrument is used for determining the sighting corrections. It is mounted in the fighting top and is worked by an officer who keeps it directed on a given point of the target ship. This instrument solves the above problem automatically, and indicates the range and speed corrections at the gun positions. It is to be presumed that a similar instrument will be introduced for aero-naval warfare. It will have two additional elements of complication, namely (6) and (7), the latter being necessary for trajectories with angles of sight varying from $+60°$ to $-90°$. On the other hand, the ranges will be much shorter than in a sea fight, and the instrument can be placed close to the gun. In spite of the complication of the gear, there is no reason why the aero-naval director should weigh more than 20 or 30 pounds.

The gun is fitted with speed sights adjustable for (1), (2), (4), (6) and (7). The sight is constructed with reference to (5). The above data having been obtained, the sight is set accordingly, and theoretically the result should be a hit, whatever the range, provided that the instruments and the observation are accurate. The only other sources of error are those inherent in the gun, the powder, and the projectile, and, so far as those are concerned, they allow us to put 50 per cent. of shots on to a target the size of a military airship at 4000 yards.

We have next to consider how far the weight of the gun imposes a limit on the radius of fire of a dirigible. The weight depends on the design of the ammunition,

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which may be incendiary, high-explosive or shrapnel shell, fired with a high or a low velocity. The **incendiary** shell contains composition which is ignited on impact on the balloon, or which burns throughout the flight. A safe fuze, sensitive enough to act on the envelope of a balloon, has not, so far as known, as yet been invented; therefore the incendiary composition must burn throughout the flight of the shell, or be ignited by a delay action fuze after travelling a certain distance. No success has, however, yet been achieved in setting fire to a balloon with an incendiary projectile of this type. The gas does not ignite at the orifice of entrance; while the flaming shell is passing through the gas it is harmless, as there is no air to combine with the gas; and the chance of igniting the gas at the orifice of exit, during the minute fraction of a second while the shell is passing out of the envelope, is small. Possibly with a very strong flame, extending several feet behind the shell, better results might be achieved: but this would require either a large shell to hold sufficient composition, or an accurate time fuze which would ignite the composition just before reaching the balloon, allowing it to burn fiercely for a short period.

The **high-explosive shell** is an ideal projectile for attacking a balloon. The detonation of even a small shell on the envelope would certainly burst the adjacent gas chambers, rip the envelope badly, and probably destroy the whole balloon. The difficulty lies in the fuze. In the ordinary percussion fuze the action is due to the check of velocity of the shell on

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impact, which causes a loose pellet inside the fuze to fly forward and strike a cap. Since there is no appreciable check when a shell passes through the envelope, this type of fuze is inapplicable.

The **trigger fuze** is illustrated in Fig. 23. The fuse is locked when fired by the whiskers shown in the drawing, which then lie close against the shell. It contains a percussion arrangement wound up by turning the head of the fuze before loading. When the shell emerges from the gun the whiskers fly out centrifugally; on striking the envelope, a touch on any one of the whiskers will release the percussion gear and fire the shell. The whiskers assist to destroy the balloon by tearing the envelope. So far as known, this fuze is still in the experimental stage.

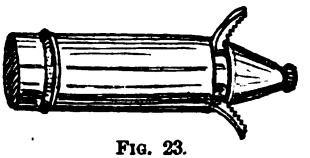

FIG. 23.

The **electric fuze** is actuated by a small dry battery carried in the shell, with a contact pin projecting to the front; when this touches the envelope it is pressed in, closing the circuit and firing the shell.

At present, however, it is uncertain whether any reliable sensitive fuze is available, and without such a fuze the high-explosive shell is useless at balloons.

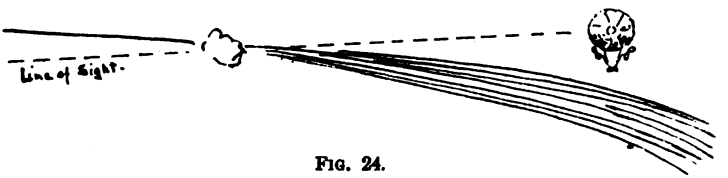

FIG. 24.

Shrapnel is not a very satisfactory projectile, unless burst close up, as the bullets only cause

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small leaks in the gas chambers or gas bag. The rubber-faced cotton cloth used for balloon envelopes is tough and elastic, and the hole made by a bullet partially closes up.

It has been proposed to use **chain bullets**, which are three bullets joined by chains about 4 inches long, or **rod bullets**, which are slender rods of lead. Bullets joined by wire spirals have also been suggested. The result would, however, be a considerable decrease in the distance from the point of burst at which the bullets would be capable of penetrating the envelope. Whatever kind of bullet be employed,

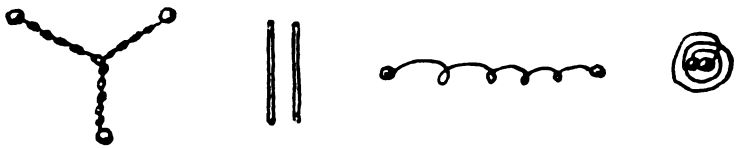

FIG. 25.

the bullet-cone droops, so that if the burst apparently covers the balloon, the bullets fall below it. Moreover, in a fight between two airships, travelling in different directions at speeds of 40 miles an hour, fuze-setting would be very much a matter of guesswork, and the chance of getting an effective time-shrapnel burst would be small. It is to be anticipated, therefore, that the sensitive fuze for the high-explosive shells will shortly make its appearance, if, indeed, it does not already exist.

When an ordinary high-explosive shell is fired from a balloon gun, then, unless it hits the target, there is nothing to show where it has gone. Therefore it has to be provided with a **smoke-trail**. This

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is produced by filling the rear half of the shell with smoke composition, consisting of black powder and phosphorus, ignited by a simple fuze on discharge. This, as it burns, leaves a plainly visible trail through the air, and enables the gunner to correct his laying if the first shell misses. It should be noted that smoke composition has so far proved ineffective as a means of setting fire to a balloon, and the shell depends for its effect on the high-explosive charge and sensitive percussion fuze. Mere perforation of the balloon by the shell is not likely to disable it immediately, and in an airship of the rigid Zeppelin type, containing a number of gas chambers, the perforation of one chamber would do little damage.

Weight of Aero-Naval Gun.

The weight of the gun depends on the weight and velocity of the shell. A high-explosive shell, with sensitive fuze and composition to give a smoke-trail over 1000 yards of flight, must weigh not less than 5 lb. The higher the velocity the easier to hit; but high velocity also increases the weight of the gun and mounting. There is no object in increasing the weight of the shell beyond 5 lb., since the detonation of a 5 lb. shell, carrying, say, 12 oz. of ammonal[1] or other high explosive, will be sufficient to disable the largest airship. Therefore the endeavour in future will be to increase the velocity of the shell in order

[1] Ammonal is mentioned as suitable because of its incendiary effect, due to the high temperature produced by the burning aluminium dust.

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to increase the range at which there is a fair prospect of a hit. For it is clear that an airship only capable of making 25 per cent. of hits at 1000 yards, and 5 per cent. at 2000, will stand a poor chance against a rival which can make 25 per cent. of hits on her at 2000 yards and 10 per cent. at 3000 yards.

With a view to the immediate future only, it may be assumed that airships will not find it worth while to expend ammunition at each other at ranges much exceeding 1000 yards. Now a 5 lb. shell fired with a muzzle velocity of 1000 feet per second will take about 3½ seconds to cover 1000 yards. In this period an airship flying at 40 miles an hour covers 70 yards, or, if two airships are flying in opposite directions at this rate, the relative displacement will be 140 yards. With good "speed sights," this is not an excessive amount to allow for, and, considering the size of the target (about 200 feet long and 30 feet high for a military dirigible of 3500 cubic yards capacity) this should afford at least 50 per cent. of hits, or a larger proportion if the firing ship is travelling end on to the other (see *Tactics*).

The problem of the gun now begins to take a definite shape. Starting with the assumption that a 5 lb. shell and M.V. of 1000 f.s. will suffice, we find that the weight of the gun alone will be about 150 lb. This will give a total recoiling weight of, say, 180 lb., a recoil velocity of 30·5 f.s., and a recoil energy of 1·165 foot-ton. Allowing 4 feet of recoil, the pull on the mounting on firing will

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be nearly 6 cwt., which is about as much as we can expect the framework of the car to stand.

By the use of differential recoil (Chapter I.) the pull can be reduced to 1½ cwt. for a 4 ft. recoil, or 3 cwt. for a 2 ft. recoil; the latter appears the best combination, as with the wide limits of elevation and traverse imposed it is not easy to find room for a recoil of 4 feet.

The mounting has to give a horizontal field of fire of 270°, and a vertical field of from + 60° to − 90°. The weight will vary according to the construction of the car, but as a rough estimate we may put it at 300 lb., including sights and recoil gear, making a total of 4 cwt. for the gun and mounting. Add ½ cwt. for the range-finder and director, and we have 4½ cwt., or the weight of three men. The ammunition, with cartridge cases of aluminium alloy,[1] will weigh 6¼ lb. per round, or 27 rounds to a man's weight, which is the ordinary unit of weight in ballooning. A liberal allowance of ammunition will be 50 rounds. Thus the whole armament, consisting of one aero-naval gun with 50 rounds, rangefinder, and director will weigh rather less than five men. Now the latest German military airship (M. III.) is capable of carrying twelve men, though it is stated that her ordinary crew will consist only of two officers and five men. Therefore there is no reason why she should not be armed with a gun on the above lines.

[1] Aluminium makes very bad cases. But for a 2 in. low-pressure gun it ought to answer, as the cases will not be required to be reloaded, but will be thrown overboard.

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Weight might be saved by reducing the ammunition to 20 rounds, which ought to be enough to decide one fight. But surplus ammunition is a good thing to carry, as it can always be expended as ballast.

We have still to consider whether one gun is sufficient for the armament of an airship. There is no difficulty about mounting a bow gun or stern gun with an arc of training of 270° or more, and

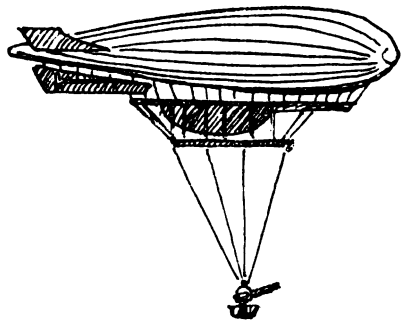

FIG. 26.

a vertical field of fire from +60° to −90°, or directly downwards. If, however, 360° of training, or complete all-round fire, be required, the problem becomes more difficult.

It may possibly be solved by suspending the gun in a separate car, revolving on a swivel, so that the whole car, with the gun, mounting and detachment, can be turned in any direction. This method would also increase the vertical field of fire. The difficulty would be the swaying of the car, however suspended, to the recoil of the gun. But this question is rather one of airship construction than of artillery. All

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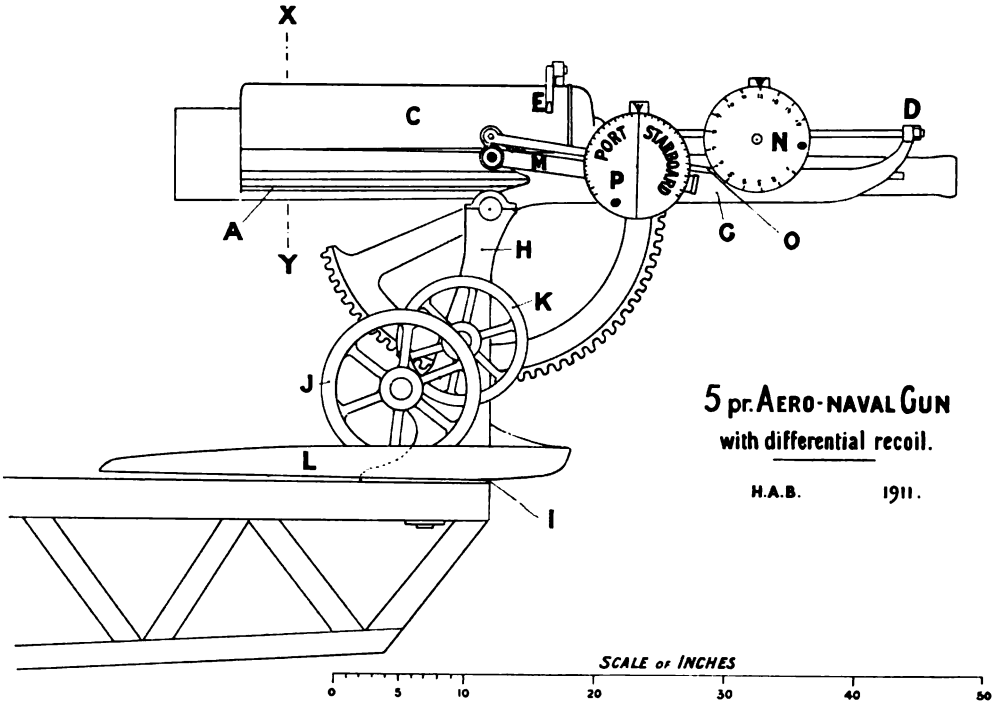

FIG 26 A.

To face page 67.

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that can safely be predicted is that since airships must fight (see Chapter XXIX.), they will be built for fighting, and the car will have to be a gun-platform as well as an engine-room, control platform, and wireless telegraphy station.

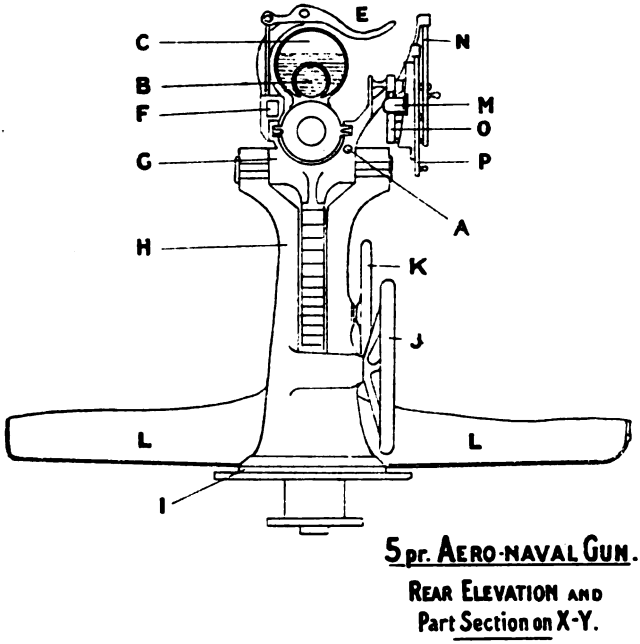

Fig. 26 B.

Figs. 26 A and 26 B represent an aero-naval gun designed by the author to comply with the conditions given above.

The gun is a 5 pr. of 2 inches calibre, mounted on the differential recoil system, which reduces the pull on the mounting on firing to 3 cwt. It is intended to be mounted either on the keel of the car, or on a forward extension of the keel of a semi-rigid dirigible. The mounting gives elevation from $+60°$ to $-90°$ with $270°$ of traverse.

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The description is as follows: The gun is of nickel steel, 30 calibres long, rifled with uniform twist, designed for a M.V. of 1000 f.s. It has eccentric screw semi-automatic breech mechanism, actuated by the rod A. The recoil gear consists of the recoil cylinder B and air reservoir C, which are fixed to the gun; the piston and piston-rod are attached to the front arch of the cradle at D. The gun is normally in the rear or loading position as in the figures. It is loaded and layed, and released by the firing lever E. The gun is then propelled forward by the expansion of the compressed air, and is fired by a tripper just as it reaches the forward position; it then recoils to the loading position, where it is held by the ratchet bar F. The length of recoil allowed is 24 inches. In case of a misfire the gun has to be hauled back to the loading position by a winch applied to the ratchet bar.

The gun slides in the trough cradle G, which is strengthened by the front arch D. The cradle is on rear trunnions so placed that the gun has a slight forward preponderance in the loading position, in which position it is layed.

The cradle is supported by the pedestal H; the pedestal, with the whole mounting and the two men working the gun, revolves on a roller ring I. It is traversed by the traversing wheel J, which can be manned by both men. The gun is elevated by the elevating wheel K. The two seats L, L for the men are railed in with wire netting (not shown).

The gun is layed by the telescope M, of which the eyepiece is set at right angles to its length; there are also open sights on the telescope. There is no correcting gear for angle of sight, as this gear forms part of the director, which instrument shows the corrected elevation, and also the corrected deflection, which is the combined deflection for speed of firing ship and speed of target ship. The sight is set for elevation by the dial N, which has a snail cam on its back, against which the rocking bar O is pressed by a spring. The sight is set for deflection by the dial P, which is mounted on the rocking bar and has on its back a snail cam with the helix at right angles to its plane, which

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traverses the telescope. This dial is coloured half red and half green for port and starboard. The dials are graduated on both sides, and are intended to be set, as a rule, by the loading number on the far side of the gun. This number has little to do, since the breech action is semi-automatic.

In action, the officer at the director calls the range and deflection, which are set by the loading number on the dials N and P. The laying number lays and fires when ready.

Four rounds of fixed ammunition, besides one in the gun, are carried in a rack (not shown) on the left of the mounting. Additional racks of four rounds are handed up by a third number, or by the officer himself, when required.

One or two minor points remain to be touched upon. It has been asserted that guns cannot be fired from an airship on account of the **concussion** and **danger of fire**. As regards concussion, it has been proved by Messrs. Krupp and others that a charge of high explosive weighing ½ kilo. exploded within 5 metres of a balloon produces no particular effect on it, and the concussion produced by firing a 5 pr. gun from the car would be far less severe, unless the gun were pointed upwards so as to barely clear the gas bag. The limits of safety in this direction have yet to be determined.

As regards danger of fire, the modern dirigible does not diffuse gas around it in the same manner as the old open-throated pear-shaped balloon, and it is considered that the danger will be no greater than with the explosion engines already employed.

It has been proposed to use compressed hydrogen or liquid air as a propellant, but the weight of the containing vessels is at present prohibitive.

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Danger to our own troops has sometimes been adduced as an objection to firing shell at an airship, or from it. It has been suggested that every shell fired should be provided with a time fuze which would explode it and break it up into small fragments before it reached the ground. But there is no good reason to suppose that this device, even if practicable, would materially reduce the danger to our troops or to the inhabitants. It seems probable that fighting airships will not refrain from firing at each other out of consideration for those below. And in any case the explosion and fall of a hostile airship is likely to be more dangerous to troops beneath it than the fall of a 5 pr. shell.

As regards the danger entailed by firing at balloons from the ground, the best means of protecting our own troops is to use a high-velocity far-ranging gun, such as the Krupp balloon gun afterwards described, which carries some 8 miles at 45° elevation. The inhabitants of the country will have to take their chance.

Rockets.

The rocket has often been proposed for the armament of airships, on account of the lightness of the discharging apparatus or rocket tube. The objection to it has been, and is still, the want of accuracy. However, recent improvements in rockets, specially designed for aero-naval purposes, have mitigated this defect. The **Unge** balloon rocket, which has been taken up by Messrs. Krupp, is a good example of modern types. The gases resulting

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from the burning of the composition are led to a central chamber, and thence escape through turbine vanes, giving the rocket a rotatory motion. The composition consists of layers of powder of different rates of combustion, so that as the rocket gathers speed the volume of the propelling gases increases. The inventor proposes a 40 lb. rocket, fired from a rifled tube or light gun weighing 140 lb., and carrying a small high-explosive shell, with sensitive fuze, in its head. It is stated that good accuracy has been obtained with this rocket, but no exact data are available. Neither is it known whether the flame from the rocket will set fire to a balloon. Considered merely as a means of propelling a high-explosive shell, the rocket would appear inferior to the gun, since 35 lb. of useless weight have to be carried for every 5 lb. shell fired. Moreover, the 140 lb. estimated for the rocket tube would probably not provide for a mounting capable of all-round and up-and-down fire. If we assume that the rocket tube and mounting weigh 2½ cwt., and that a total weight of 6 cwt. is available for gun, mounting, and ammunition, we shall get a rocket tube and 10 rockets as against a gun and 25 rounds of shell. And since we may roughly estimate that the shell will be twice as accurate as the rocket, even at a range of 500 yards, it follows that, on the above somewhat conjectural assumptions, a dirigible armed with rockets would be at a disadvantage compared to one armed with a gun. But until the question has been settled either by the ordeal of combat or

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at least by practical experiment, it would be rash to dogmatize as to the outcome.

Armament of Aeroplanes.

The present type of military aeroplane is a light craft which can be packed in a wagon and taken into the field with the troops. It is only constructed to carry two men; if made larger it would become unwieldy and difficult to start without special launching ways, and would require a shed for its protection. It is clear, therefore, that the present type cannot carry a gun weighing 3 cwt. with an additional man to work it. Moreover, the vibration of the framework would render it necessary to stop the engine in order to fire; this is easy in a dirigible, but is risky in an aeroplane. It would appear therefore that a repeating rifle is the only weapon which the aviator can carry. It has been proposed to carry grenades or high-explosive shell for fighting dirigibles, the idea being to rise above the dirigible and drop the shell on her. A grenade of this type is illustrated in Chapter XXIX. But probably a star-shaped arrangement of scythe blades would be as effective as a shell if dropped on top of the gas bag, and would be safer to handle.

GUNS FOR THE ATTACK OF AIRSHIPS.

As in the case of the aero-naval gun, the design of the gun depends on the ammunition, and this upon the method of attack. The target is a rigid balloon of the Zeppelin type, containing 50 gas chambers, or

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a semi-rigid balloon (that is, a gas bag stiffened by a keel) of the Gross or Parseval type, containing 4 or 5 compartments and ballonettes. Time shrapnel, as already explained, is unsatisfactory, and high-explosive shell will be used with a sensitive fuze, which will presumably soon be available. The shell will have a good smoke-trail. With good speed sights there is a fair prospect of hitting a dirigible at 5000 yards when firing from the ground, and the ammunition will therefore be constructed to give a smoke-trail over 6000 yards at least. This means a shell weighing not less than 12 pounds. And, to reduce the chance of error at the moving target, this shell will be fired from a high-velocity gun.

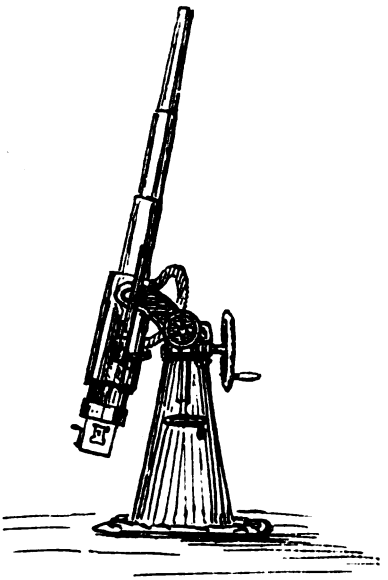

FIG. 27.

The only balloon guns about which any information has been published are the guns made by Krupp, Vickers Maxim, and Schneider, and the French balloon gun. But it is understood that trials are being carried out in most countries of Europe. The balloon guns hitherto made are of two classes, namely, guns of position (including naval guns) and field

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guns. The former type are 4·7 in. or 4 in. high-velocity guns on pivot mountings giving high elevation, as in the sketch on page 73, which represents a 40 pr. with M.V. 2400 f.s. This gun has special rapid traversing gear, but it would appear preferable to elevate and traverse from a large curved shoulder-piece, the force applied being assisted by automatic electric gear on the principle of the steam steering gear, and the layer's stand being made to traverse with the gun. However, guns of this nature are beyond the scope of the present volume.

Field Balloon Guns.

No field carriage has yet been designed which allows of the gun being elevated and traversed with sufficient rapidity to engage an airship. For it must be remembered that a dirigible passing across the front of a gun at a range of 1000 yards and at a speed of 40 miles an hour will traverse an arc of 60° in one minute. Therefore the mounting has to be a pedestal similar to that of a gun of position, but on a smaller scale.

The **Krupp field balloon gun** is illustrated in Plate X. It is a 12 pr. of 75 mm. calibre, 35 calibres long, with M.V. of 2050 f.s. The greatest height of the trajectory at 75° elevation is 20,000 feet, and up to 5000 feet the trajectory is very flat, which facilitates ranging. It is mounted on a travelling platform drawn by a motor car, the weight behind the car, with ammunition and detachment of six men, being 4¾ tons. The car is specially fitted with an indepen-

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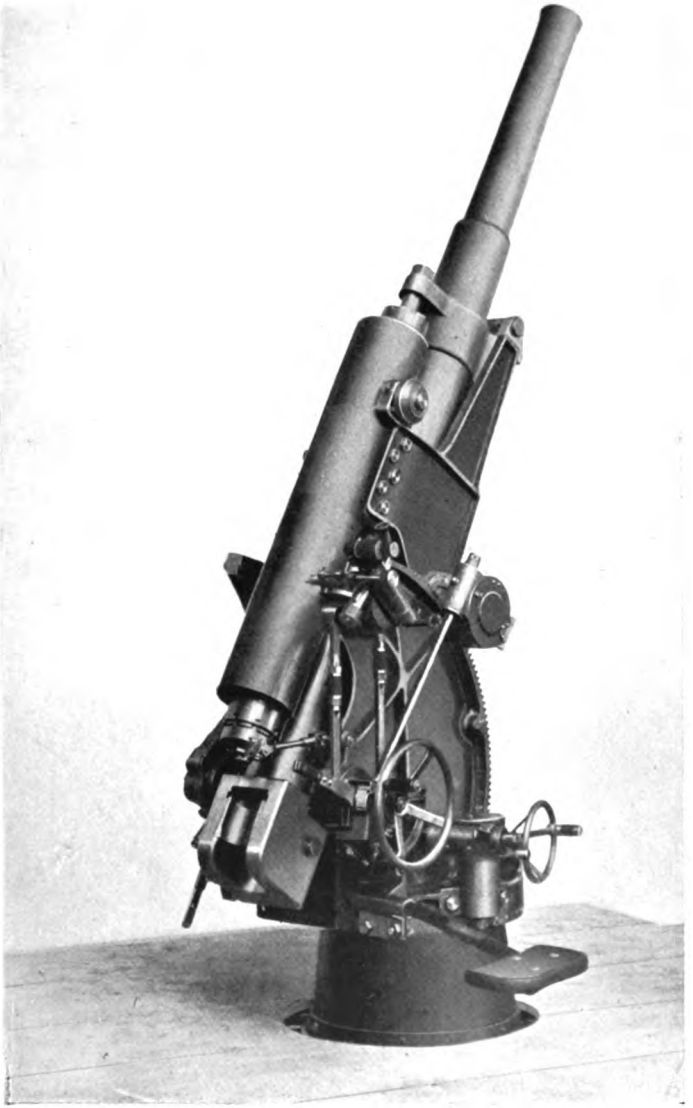

PLATE X.—KRUPP 12 PR. BALLOON GUN ON TRANSPORTABLE PLATFORM.

To face p. 74.

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dent drive to the fore and hind wheels, which enables it to travel over moderately rough ground, such as sound pasture or arable land. The recoil of this gun, if mounted in the ordinary way, would cause violent vibration of the platform; it is therefore fitted with differential recoil gear (see *Recoil Gear*) and compressed air running-up gear, which are contained in the casing seen above the gun. For convenience of loading, the gun is on rear trunnions, so that the breech is not raised out of the loading number's reach when the gun is depressed. The breech action is the semi-automatic wedge (see *Breech Actions*) which not only permits of a rate of fire of 30 rounds per minute, but holds the cartridge fast when loaded at full elevation, since the breech-block begins to close as soon as the extractor is pressed back by inserting the cartridge. The gun fires shell of which the front half is filled with high explosive, while the rear half contains smoke composition which gives a good smoke-trail up to 6600 yards. The shell is fuzed with a sensitive fuze, of which the details are kept secret, which, it is stated, will act on the envelope of a balloon.

The illustration on page 76, taken from a photograph, shows the effect of a Krupp 12 pr. high-explosive shell on a small spherical balloon, when burst on the envelope. The explosion has cut the balloon in two, and the upper portion has disappeared altogether, being presumably burnt up. The lower half of the envelope has turned inside out, and is seen sinking with the car. The smoke-trail

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left by the shell is plainly visible. The black cloud may be partly caused by the burning of the envelope; but is principally due to the dispersion of the unexpended smoke composition by the bursting of the shell.

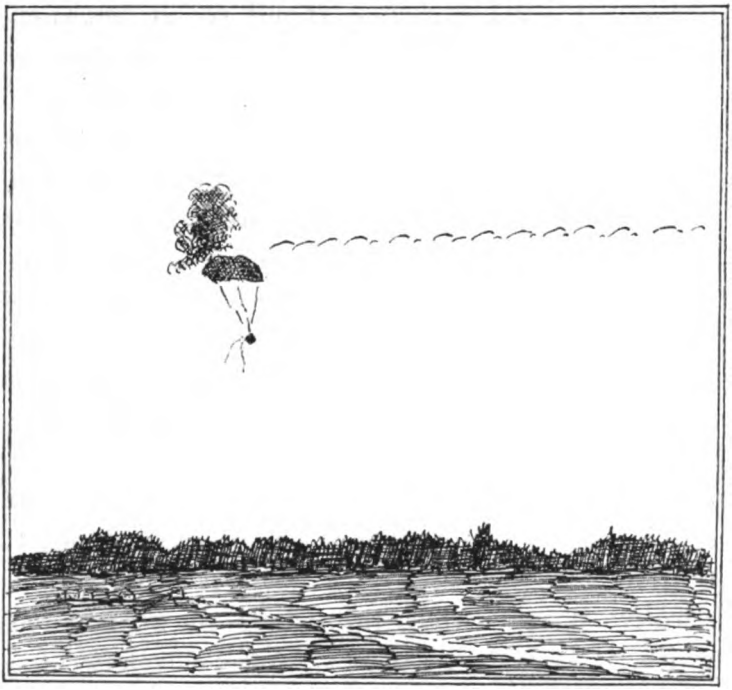

Fig. 28.

Messrs. Krupp have also brought out a wheeled 9 pr. balloon gun for countries where the roads are too bad for motor traction. This is shown in Fig. 29. The wheels turn inwards on pivots like those of the front axle of a motor car, so that the carriage can be quickly traversed. This equipment cannot compare in efficiency with the Krupp 12 pr.

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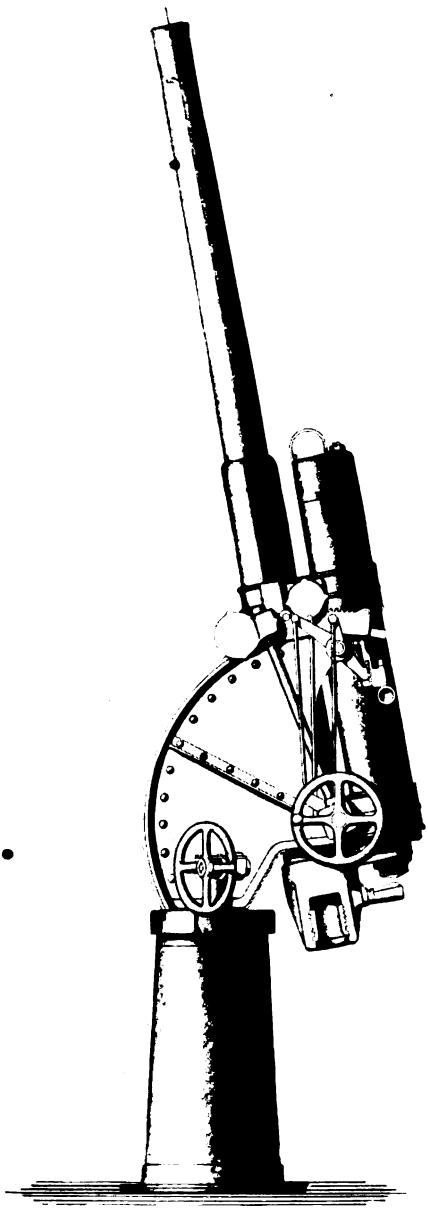

PLATE XI.—VICKERS MAXIM 3 PR. BALLOON GUN, 1910.

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Messrs. Ehrhardt have recently brought out a 12 pr. balloon gun on pivot and travelling platform. It is 35 calibres long, and has a M.V. of 2135 f.s.

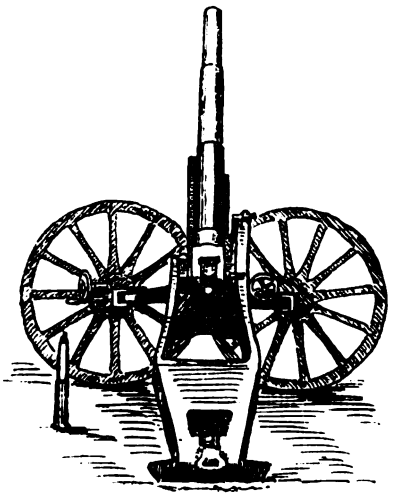

Fig. 29.

The **Vickers Maxim** 3 pr. balloon gun is shown in Plate XI. It is a high-velocity 3 pr. on pivot mounting, which may either be fixed or fitted on a transportable platform. The breech action has a catch to hold the cartridge, so that it can be loaded at any elevation. The telescopic sight, with part of the correcting gear, is visible on the left of the gun. This is a handy little weapon, but the shell seems too small to fulfil the requirements for an effective balloon-destroying projectile.

The same criticism applies to the **Schneider** 47 mm. balloon gun, which is very similar to the Vickers Maxim. This gun was originally intended to be

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mounted on a motor car with armoured cupola. The object of the cupola is not apparent.

The **French balloon gun**, which appeared at the 1910 manœuvres, is shown in the annexed sketch. It is said to be an 11 pr. of 2·75 in. calibre, M.V. 1970 f.s. It is 35 calibres long, and has the eccentric screw breech action. The gun is fitted with differential recoil gear; there is no buffer,

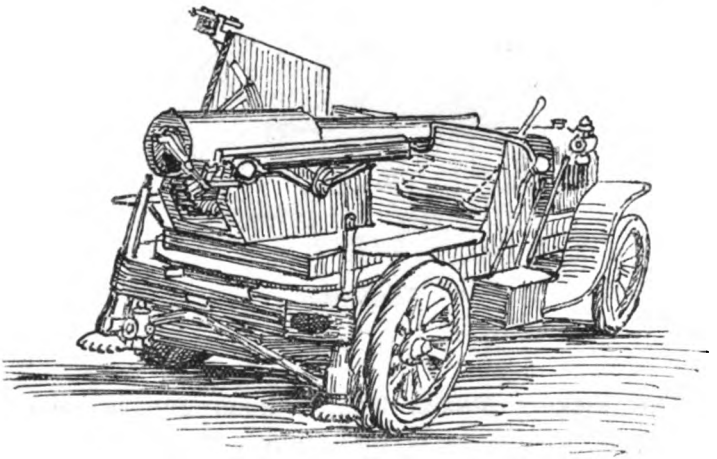

Fig. 30.

and the whole of the recoil is taken on the compressed air. The cradle is mounted on rear trunnions, and is elevated by means of a toothed arc. The gun and upper carriage traverse on a vertical pivot, but it would appear that the arc of training is limited to 90 degrees, which considerably detracts from the utility of the gun.

The peculiarity of the French balloon gun lies in the appliance for relieving the car on which it is mounted from the firing strain. Before firing, the

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two jacks seen in the figure at the rear of the car are screwed down until the hind wheels are raised off the ground. The car is of 50 H.P., and is said to weigh 2 tons complete without the men. The ammunition is carried on a second car.

The sighting apparatus is seen on the left of the gun; it is a short straight telescope fitted with speed sights and corrected for angle of sight. A one-man rangefinder is carried on the second car.

The details of the ammunition are kept secret, but the shell is said to carry a high-explosive charge in the head with sensitive fuze, and to leave a smoke-trail behind it.

Sights for Balloon Guns.

The sight is a short telescope with large field, with the eye-piece at right angles to its length. It is similar to the rocking bar sight already described (see the 18 pr. sight), but has a special correction for angle of sight. This is required for the following reason: A balloon at a given distance from the muzzle requires less and less sighting elevation as it rises, till, when vertically over the gun, the sighting elevation is *nil*, and the axis of the gun points straight at the balloon. In the **Krupp** balloon guns this is allowed for by fitting a shifting index to the scale on which the elevation is set; this index is connected to the mounting so as to shift as the telescope is pointed higher. Thus if the sight be set at 4000 for a balloon 4000 yards distant and 500 feet high, the actual elevation given will be, say, 8 degrees,

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while if the balloon rises to 3000 feet the elevation given by the same setting of the sight will be only some 4 degrees, and if it comes vertically over the gun the elevation will be *nil* at whatever range the sight is set.

This peculiar action of the sight entails a somewhat complicated construction, and it has been proposed to transfer the complication to a separate instrument. In any case the balloon gun must be accompanied by a one-man rangefinder to measure the rapidly-varying range of the balloon; and if this rangefinder be mounted on a truly vertical pivot, it can be constructed so as to show the sighting elevation, not the range, for a balloon at any height and at any distance. Moreover, if it be fitted with a time attachment, such as a metronome, or a drum rotated by clockwork at a given speed, the rangefinder can be made to show the rate of angular movement of the balloon, and hence the speed correction which has to be given on the sight. This arrangement would appear preferable to fitting correcting gear to the gun sights, for two reasons. One is that the accuracy of the correction depends upon the pivot being truly vertical, which is easier to secure with a rangefinder than with a travelling gun-mounting. The other reason is that the complicated gearing can be made lighter if embodied in the rangefinder than if attached to the gun, where it is exposed to considerable shock and vibration during rapid fire.

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Guns for the Attack of Aeroplanes.

The aeroplane is a difficult target on account of the small amount of vulnerable surface which it exposes. The planes might be riddled with shrapnel bullets without doing much harm, while the chance of hitting the aviator is small. The only projectile which promises good effect is the high-explosive shell, which would probably rip the planes and break up the framework. And for this nature of fire the balloon gun already described is the most suitable.

APPARATUS FOR DROPPING SHELL FROM AIRSHIPS.

No Convention is likely to prevent this from being done. It is stated in the German Press that apparatus for this purpose has been fitted to the latest German military dirigibles, but the details are kept secret. The general principle of such devices is however well known, being the same as that of the torpedo director used in the Navy.

In a dirigible balloon an extra complication has, however, to be faced, since it is necessary to determine the speed and direction of the dirigible with reference to the ground. When a wind is blowing, these are not necessarily the same as the speed and direction through the air.

The following is one of many possible constructions suited to the purpose:

The layer reads off from a scale attached to the barometer the time taken by the shell to fall, say

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10 seconds, which corresponds to a height of some 1600 feet. He then sets a pendulum clock or metronome to tick once in 10 seconds. He directs his sight-bar on any object on the ground, and keeps the sight on, by working his elevating and traversing[1] wheels, for 10 seconds or a multiple of 10 seconds. The amount of motion of these wheels gives the speed correction and deflection required. These being set on the sight, the layer waits while the helmsman manœuvres the ship so as to bring the sights on to the target. At this moment the layer releases a catch and allows the shell to drop. It will be noted that, when the airship is making any leeway, her head must point to windward of the target in order to pass over it.

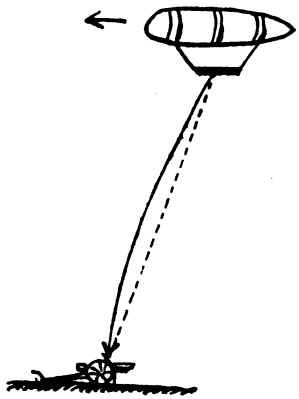

Fig. 31.

The full line represents the path of the shell, the dotted line the line of sight.

The accuracy of the sighting depends upon the angle, both forward and lateral, which the sight-bar makes with the vertical and with the keel of the airship when the sights come on to the target.

This is shown, as regards the forward angle, in Fig. 31.

The angle of the sight-bar must be measured with reference to a truly horizontal plane; therefore the

[1] These names are not strictly applicable, but the aeronautical equivalents do not yet exist.

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sight has to be mounted on a base-plate which is kept levelled, during the whole operation, by an assistant.

The accuracy of the shooting is affected by errors in steering, error as to the exact moment of releasing the shell, variation in speed and direction of the airship due to varying wind, and effect of wind on the falling shell. In some dirigibles the vibration caused by the engine will affect the sighting. Since the vertical range will rarely exceed 1000 yards, there is no reason why accurate practice should not be made on a moderately still day. In a gusty wind the shooting is likely to be wild, even if the airship be steered directly before the wind or against it, which are the best points of sailing for shell-dropping.

The **projectiles dropped from an airship** may be high-explosive shell or time shrapnel. In the latter case the fuze will be set in action when the shell is released. The striking velocity of the shell will be very low, only 32 feet per second of flight, or 320 f.s. for a height of 1600 feet. Therefore the velocity of the bullets will have to be increased by a driving charge in the base. Whether an ordinary shell can be trusted to drop point first seems doubtful, but there will be no difficulty in fitting a tail to it if necessary.

A projected design for a special shell for dropping from an airship is given in Fig. 32.

The shell is of conical shape with the centre of gravity near the thick end, to ensure its falling with

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the thick end leading. It is filled with bullets, with a driving charge of powder above them. It is fuzed with a clockwork fuze as made by Messrs. Krupp (see *Ammunition*). This is wound up by turning the knob *a*, set to the time of fall corresponding to the height by turning the milled head *b*, and set in action by withdrawing the key *c* by which it is suspended.

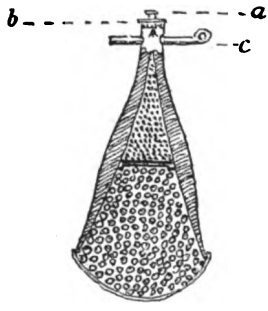

FIG. 32.

Vertical shrapnel fire from a balloon seems more likely to be effective than shell fire, especially at a target such as troops encamped or in close formation.

Since continuous vertical fire from a balloon will be impossible, heavy shell weighing 50 to 100 lb. will be used. Six-inch howitzer shell, which weigh about 90 lb., will be suitable. One such shell, containing 1500 bullets of 35 to the pound, would cause considerable damage if burst over an artillery camp.

A military dirigible of the type favoured on the Continent is usually capable of carrying 12 men. For an attack on the enemy, six of these might be left behind, which would allow 900 lb. of ammunition, or ten 90 lb. shell, to be taken on board.

The damage which might be done by dropping explosives is commonly over-estimated. Suppose that a dirigible carried three 300 lb. mine shell, specially made to contain each 250 lbs. of dynamite. The explosion of one of these shell would only wreck a single building of a town, arsenal, or dockyard,

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though the moral effect, if it were dropped in the right place, might be valuable. Against troops in the open, the effect would probably be limited to a radius of 50 yards. Against a battleship, vertical fire with dynamite shell would be effective; but this is a naval matter with which the present writer is not competent to deal.

An **aeroplane** would have to carry two men at least, to drop shells with any precision, and the weight of ammunition that could be carried would be so small as to render vertical fire not worth attempting.

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CHAPTER VI.

AMMUNITION.

A Q.F. gun fires **fixed ammunition** similar to that used in small-arms. A round of ammunition consists

FIG. 33.

of the shell, with burster and fuze, the brass cartridge case, the charge, and the primer.

Powder.

Smokeless gunpowder consists of gun-cotton, with or without the admixture of nitro-glycerine. It is of a horny texture, so as to burn regularly without liability to detonation (see below). It is made in cords, tubes, or leaves, the fineness of which determines the exposed surface and so the rate of combustion; thus coarse powder is used in long heavy guns, and fine powder in short mountain guns. The more nitro-glycerine the powder contains, the "hotter" it is; in heavy guns this is a serious matter, as the surface of the bore is burnt away, but little trouble from this cause is experienced in field

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guns. Our own powder is called "cordite M.D.," and consists of 65 parts gun-cotton, 30 nitro-glycerine, and 5 vaseline. It probably stands tropical heat better and longer than any other powder at present in use. It is waterproof, gives very regular pressures, and is very safe to handle except when frozen, when the nitro-glycerine sweats out.

Most other nations use gun-cotton powder, except for howitzers. A reduced charge of gun-cotton ignited in a large chamber gives irregular velocities, and powder containing 50 per cent. of nitro-glycerine (such as *ballistite*) is used in foreign howitzers on this account.

The charge is ignited by a **primer** in the base of the cartridge, consisting of a percussion cap which is fired by the striker of the lock, and a small charge of black or smokeless powder.

The **cartridge** is of solid drawn brass, and for guns is exactly similar to a small-arm cartridge. For howitzers the cartridge is separate from the shell, for convenience of reducing the charge (see *Artillery Fire*).

The Shell.

This is either a **shrapnel** or a **high-explosive** shell.

A shrapnel consists of a thin steel case filled with bullets, with a driving charge of black powder behind them. This is ignited, before the shell strikes the ground, by the flash from the time fuze. The effect is to blow the bullets out forward in a compact sheaf. A shrapnel is in effect a short gun loaded with

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bullets, projected towards the enemy and discharged just before it reaches him. The Armstrong 14·3 pr. shrapnel illustrated in Fig. 34 contains 7¼ lb. of bullets.

The fuze can also be set to percussion, that is, to act on striking the ground or the target. This is useful for ranging or for direct fire at guns or houses, but the bullets mostly go harmlessly up into the air.

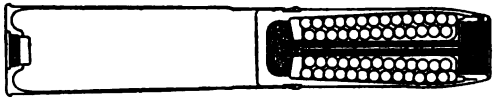

FIG. 34.

In order to render the burst of the shrapnel more visible in ranging, it is usual to put in **smoke composition** among the bullets, consisting of red phosphorus and black powder, or coarse black powder alone. In our own 18 pr. shrapnel, which gives a conspicuous burst, the use of smoke composition is considered unnecessary.

A **high-explosive shell** is a thick steel case filled with picric acid or other explosive (see below). Thin steel shell, containing a greater bulk of explosive, are called **mine shell**, and are sometimes used with heavy howitzers. Being much lighter than ordinary shell of the same length, they range differently, and require a separate range table. H.E. (high-explosive) shell are always fired to burst on impact.

The **explosive** used as a burster may be **picric acid**, also called lyddite, melinite, pertite, or shimosé; **ammonal**, which consists of nitrate of ammonia and aluminium dust; or **trinitrotoluol** (T.N.T.) which is

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also called trotyl, tribol, or trilite. Various other explosives are employed such as gun-cotton powder, used in the Swiss shell, and C/98, a mixture of nitro-glycerine and gun-cotton powders, used in the German shell.

A H.E. shell is expected to **detonate** on impact, not merely to explode. This means that the powder not only burns over all its exposed surface, but that the initial force of the explosion breaks down the structure of the grains so that the flash reaches every particle of the mass at once. It is difficult to obtain complete detonation of any of the above-mentioned explosives in a field shell without the use of a strong fulminate primer, which is liable to explode in the limber or in the gun. In order to dispense with fulminate, an **exploder** is used consisting of a substance more readily detonated than the mass of the burster, such as picrate of ammonia or fine-grain nitro-glycerine powder. This is started by a very small fulminate primer, or even by a cap, and its explosion causes the detonation of the whole mass. Krupp uses a first exploder, fired by the flash from the fuze, enclosed in a strong steel cylinder; this bursts violently, and partially detonates the second exploder, which in turn completely detonates the burster. The first exploder consists of gun-cotton powder, the second of loose crystals of T.N.T., and the main burster of T.N.T. cast in a solid block. This system is called *progressive detonation.*

Detonation may be recognized by the violent report and almost complete absence of smoke. If

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green and yellow fumes are seen, this means that the shell has opened before sufficient pressure was obtained to cause detonation, and that the picric acid, or most of it, is harmlessly burning away.

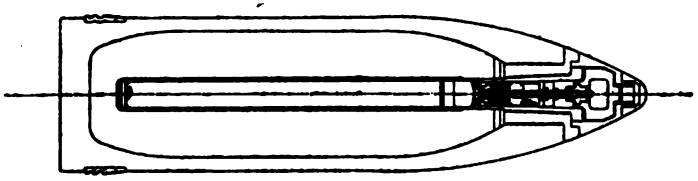

Fig. 35.

A high-explosive shell by the Coventry Ordnance Works is shown in Fig. 35. It is of good modern design, the head being struck with a radius of 4 calibres. The main burster is of T.N.T., the central exploder of picric powder, and the detonator of special fine-grain powder.

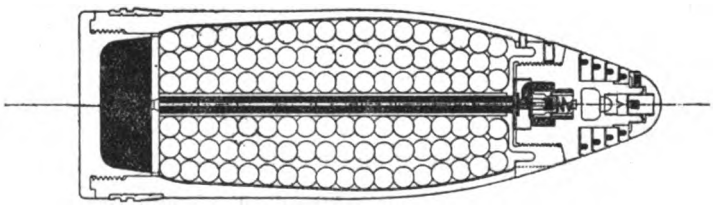

Fig. 36.

A solid-drawn howitzer shrapnel by the same firm is shown in Fig. 36. This shell presents several points of interest. The head is very long and pointed; the time and percussion fuze is a four-decker (see *Fuzes*); the base is screwed in; the driving band has a long serrated cone which grips the rifling so that the shell does not drop back when the howitzer is elevated. The base burster is of

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compressed powder, with a primer of special fine-grain powder in the centre, and is intended to give an additional velocity of 300 f.s. to the bullets: the latter constitute 53 per cent. of the weight of the complete shell.

Pointed Shell.

The ordinary field shell has an ogival head struck with a radius of 2 diameters. By using a more pointed shell, on the principle of the modern pointed bullet, a longer range and flatter trajectory can be obtained, giving better shrapnel effect. Thus the Armstrong 1910 field gun fires a shell with a 4-diameter head. The pointed form involves a certain loss of bullet capacity for the same weight of shell, but this is compensated for by the flatter angle of descent. The reason why pointed shell have not been introduced for existing equipments is that their introduction would render the present limbers and wagons useless, as the pointed shell would be too long for them; the large existing supplies of ammunition would become obsolete, and all sights would have to be re-graduated.

Universal Shell.

Many attempts have been made to construct a projectile which shall be efficient either as a shrapnel or as a high-explosive shell. If the bullets of a shrapnel be packed in T.N.T. instead of resin, then this will burn and act as a smoke-producer if the shell be burst in air. But if a primer, actuated only by

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the percussion part of the fuze, be embodied in the shell, then the T.N.T. will detonate on impact and the shrapnel will burst with destructive violence. No great success has been obtained with this method, and the only two existing universal shell are combined shell, consisting of a complete shrapnel and complete H.E. shell joined together. In the Krupp universal shell the front portion is separated from the rear portion by a partition formed in the metal of the body; the front portion is an ordinary shrapnel, the rear portion an ordinary H.E. shell with base fuze. In the Ehrhardt universal shell, which has been adopted for the German field howitzer, the high explosive is in the head of the shrapnel, and the flash from the fuze passes round it to the powder charge in the base of the shrapnel when the shell is burst in air; the head is then blown off and flies forward among the bullets, bursting on striking the ground. When burst on impact, the head detonates, giving considerable explosive effect. The spaces between the bullets are also filled with high explosive, which is intended to detonate on impact, but it is stated that this effect cannot be reckoned upon unless the shell strikes a rock or solid body such as a gun-carriage.

The Ehrhardt universal shell for field guns, which is similar in construction to the howitzer shell, is illustrated in the annexed figure. When burst in air the flame from the composition of the time fuze passes down the diagonal channel and central channel and ignites the base burster, which blows out the

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bullets and the head. When burst on impact the percusssion portion of the fuze ignites the fulminate detonator A, which successively detonates the first and second exploders B and C and the main burster D. In a 14·3 lb. shell the head contains 2·8 oz. of T.N.T., and the body contains 5¼ oz. of T.N.T. among the bullets. The bullets weigh 5·65 lb., or 39·5 per cent. of the weight of the fuzed shell.

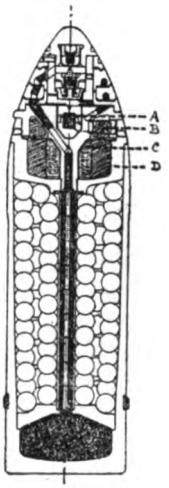

FIG. 37.

The objection to the universal shell is the loss of efficiency as a shrapnel; thus the combined shell contains less than 40 per cent. of its weight of bullets, while 50 per cent. is obtained with ordinary shrapnel. Its principal advantage is the increased effect against shielded guns. (See *Artillery Fire.*)

Various special natures of shell are occasionally used. These include *star shell*, containing firework stars instead of shrapnel bullets, used for illuminating, and *segment shell*, packed with cast-iron segments, which are effective among rocks. *Case shot* are obsolete; the old case shot was a canister of bullets which broke up in the gun, but has been superseded, as shrapnel with fuze set to burst at the muzzle is more effective.

The Fuze.

Fuzes are of two natures, **percussion** (P.) and **time and percussion** (T. & P.). The first act on impact alone, the second either in flight or on impact.

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The ordinary percussion fuze contains a loose pellet which flies forward and strikes a cap when the velocity of the shell is checked on impact. The Krupp arrangement is shown in Fig. 38. This is a typical modern construction. On discharge the collar *a* sets back, bends down the ends of the stirrup spring *b*, and fixes itself firmly on the pellet *c*. The light spiral spring, called a creep spring, prevents the pellet from working forward in flight. On impact the pellet flies forward and drives the needle point into the cap *d*. The flash from the cap, reinforced by the black powder in the pellet, passes out through the hole in the bottom of the fuze and fires the shell.

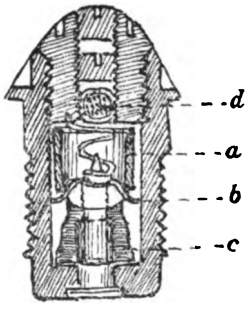

Fig. 38.

The **Schneider centrifugal percussion fuze** is shown in the annexed figure. It is specially intended for use with the reduced charges of howitzers, with which the shock of discharge is insufficient to "arm" an ordinary fuze. On discharge the guard A sets back and releases the weights B, which then fly out centrifugally and set the pellet C free. On impact the pellet sets forward against the needle and fires the cap.

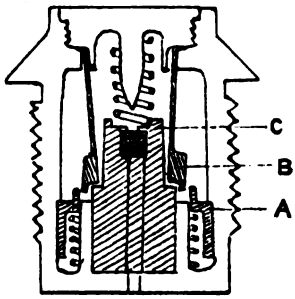

Fig. 39.

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The ordinary time fuze is shown in the annexed figure, which represents a T. & P. fuze made by Armstrong. The time composition is contained in the U-shaped channels; it is ignited on discharge by the setting back of the pellet in the nose of the fuze. The composition then burns till it reaches the powder-channel and explodes the shell. The length of composition which has to burn before this happens is determined by turning the loose ring containing the composition. The percussion arrangement is contained in the stem of the fuze.

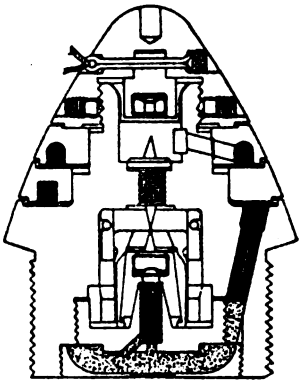

FIG. 40.

Mechanical Time Fuzes.

The rate of burning of the ordinary composition fuze is affected by the velocity of the shell, the density of the air, the age of the composition, and many other causes. Many varieties of mechanical fuze have been tried in the endeavour to secure more accurate results. The best-known varieties are the **flag** fuze and the **clockwork** fuze. The principle of the flag fuze is shown in the figure. The flag is kept

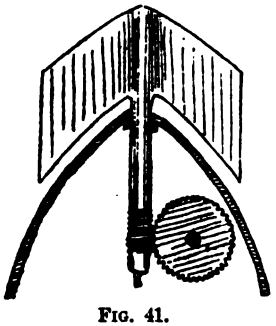

FIG. 41.

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from turning by the resistance of the air, while the shell rotates about it. This relative motion turns the toothed wheel, which is connected to gearing which releases a spring and fires the cap of the fuze after a given number of revolutions. The rate at which the shell rotates about the spindle of the flag depends on the pitch of the rifling, which does not vary. The number of revolutions after which the fuze is to act is regulated before firing in the same manner as in setting an alarum clock. Flag fuzes, as at present made, are very liable to jam on firing; when this does not happen, they give very good results.

The **Baker clockwork fuze**, as made by Messrs. Krupp, is shown in Fig. 42. It contains a spring clock with an extra rapid cylinder escapement giving 30 beats to the second. The clock is wound beforehand, and is released and allowed to go by a centrifugal bolt which flies outwards when the shell begins to rotate. By turning the dome, the clock can be set to fire the fuze within one beat, corresponding to about 10 yards at medium ranges. The stem of the fuze contains the percussion arrangement already described. The makers state that this fuze is reliable in action, and about 20 per cent. more accurate than composition fuzes. It has not, however, been generally adopted.

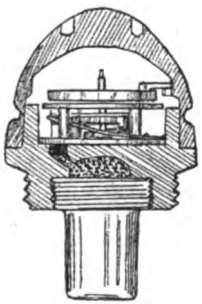

FIG. 42.

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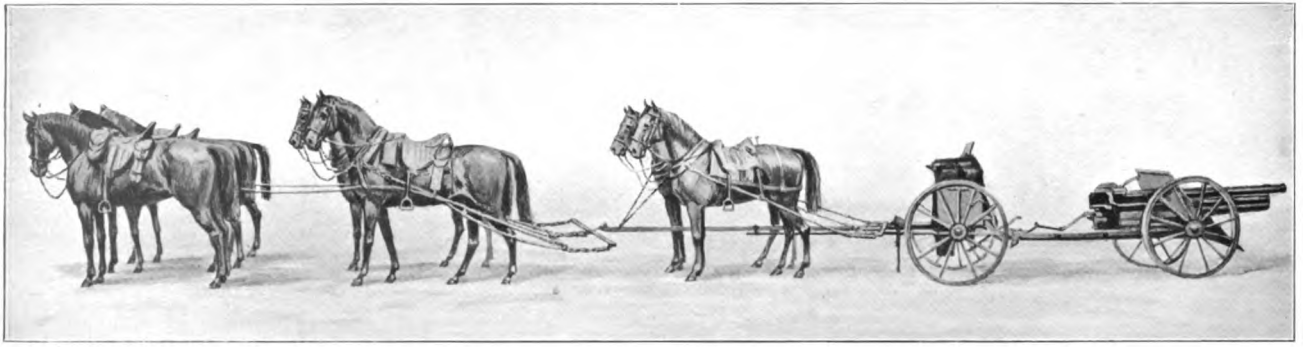

PLATE XII.—EHRHARDT QUICK-FIRING FIELD GUN WITH TEAM, SHOWING GERMAN SYSTEM OF DRAUGHT.

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CHAPTER VII.

ARTILLERY DRAUGHT.

A FIELD gun is drawn by six horses, this number being found to give the best combination of power and handiness. Each pair of horses is driven by a driver mounted on the near horse. Breast harness is used, as when horses get thin on active service the collars fitted to them in peace time become too large. In our own service the wheelers' traces are attached to swingletrees hooked to the splinter-bar, and the leaders' traces are attached to continuations of the wheel traces. In Germany the leaders are hooked in to a "master bar" attached to the point of the pole. The weight of the pole is suspended from the wheelers' necks by pole straps; we use a pole bar upon which the pole rests. In all modern equipments the loops on the splinter-bar to which the swingletrees are hooked are fitted with springs to ease the draught.

The German system of pole draught is illustrated in Plate XII., which shows an Ehrhardt 75 mm. Q.F. gun with team. In this case the horses have collars. The German system works very well on the road, as the pull of the leaders is equalized by the master bar,

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but does not come up to our ideas of efficiency across country, as the pole hangs too low and is liable to fly about.

The gun and wagon, and all carriages intended to move off the road, are limbered vehicles, the two portions of the vehicle being connected by the limber hook and trail eye or perch eye, which form a flexible connection. The limber hook, as well as the draught loops, is now usually fitted with a spring.

Vehicles in which the load is carried on springs travel more easily than springless vehicles, and it is generally estimated that four horses can pull the same load on springs as six horses can pull without them. Numerous attempts have therefore been made to carry ammunition boxes on steel or rubber block springs, but no springs capable of standing cross-country work have yet been devised.

Spring wheels for artillery have been frequently tried. The **Papone** spring wheel, which depends on the cushioning effect of air in the hollow nave, gave good results in Italy. A gun and wagon were driven down a 3 foot drop on to rock without injury. But the general objection to the spring wheels hitherto tried is that, though they answer well when subjected to violent tests, they will not stand the wear and tear of ordinary running.

Ball bearings for artillery wheels have been tried and discarded. According to French experiments with ordinary artillery carriages, the friction at the axletree arms amounts only to 1 per cent. of the draught.

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The wheels are made as large as the weights permit; this subject has already been considered under *Steadiness of Carriage.*

The best distribution of the weight of the carriage for ease of draught is obtained by dividing the weight between the fore and hind wheels in the proportion of 4 to 5, or nearly so, but this condition has to be subordinated to the necessity for power and weight in the gun; and in our own service, for instance, the weight on the limber wheels is 16 cwt., and that on the gun wheels 24 cwt., or as 2 to 3. Carriage weights are always reckoned without the men, as these will usually be dismounted on service.

In heavy field guns and heavy howitzers the weight on the gun wheels in the firing position is excessive for travelling, and the gun, after limbering up, is therefore shifted to a travelling position, so that the weight is fairly divided between the gun and limber wheels. In some heavy equipments (such as the French Rimailho) the gun is carried on a separate gun-wagon and shifted on to its carriage when brought into action.

Pole Draught.

In muzzle-loading days it was customary to use shaft draught, the off-wheel horse (then styled the *hand wheeler*) being in the shafts. This method gave perfect control of the carriage, and was useful in the old days of elaborate drill evolutions. But the shaft horse did nearly the whole of the work in holding back and turning, and had to be a better

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horse than the rest of the team. Moreover, a special set of shaft harness had to be carried. With pole draught the six horses share the draught equally, and are all harnessed alike, since the wheel harness is part of the equipment of the limber. When the team is unhooked the wheel harness is detached by the "rapid release" gear shown in the figure. This takes the place of buckles, as by pulling out the strap the breeching is detached, and remains on the limber.

FIG. 43.

Weights.

The mobility of a carriage at a walk is determined by its weight, the mobility at a trot or gallop by the weight of the carriage and the men seated on it. In the great Continental armies it is held that field guns will rarely move out of a walk on service, and then only for short distances, as in deploying from the column of march. The weight of the equipment is therefore fixed with reference to draught at a walk, without gunners. The weight arrived at in different countries is as follows:

England, F.A.	40 cwt.	Austria	37·5 cwt.
England, H.A.	32·75 „	Russia	38·5 „
France	37 „	Italy	33·5 „
Germany	34·4 „	Spain	34 „

It is interesting to note that the two countries with the most recent experience of war, namely, Russia and ourselves, have the heaviest equipments.

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Of the remainder, the German 15 pr. is a converted gun, inferior in power, and only retained because of the heavy expense of re-armament; the Austrian gun carries 1 cwt. of extra weight because it is of bronze instead of steel; and the Italian and Spanish guns are made specially light to suit the small horses of those countries.

For **horse artillery**, the weight of the gun should be such as to give good mobility at the trot and gallop. About 30 cwt. behind the team is the best weight, but this is generally exceeded, on account of the necessity (in a large army) of having a gun that will fire the same ammunition as the field gun. In horse artillery all the men of the detachment are mounted, and the seats on the limber are only provided for emergencies.

Field howitzers are made of the same weight behind the team as the field gun. Before the advent of the shielded gun, the howitzer was looked upon as rather an encumbrance, and was a slow-moving weapon kept in reserve till required to bombard a field work. Now-a-days the field howitzer is always required in the fighting line, as field gun time shrapnel is practically ineffective against shielded guns.

Heavy field guns and howitzers vary considerably in weight. Thus the French Rimailho heavy howitzer is divided into loads of 48 cwt., which enables the teams to trot on good level roads. Other nations consider that heavy artillery need not move out of a walk, and use heavier weapons; thus the German heavy howitzer weighs 54 cwt. behind the team.

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With eight heavy horses, the limit of weight possible is about 5 tons.

Carrying Detachments.

At the most, a Q.F. gun carries 36 rounds in the limber, or less than two minutes' supply. It has therefore to be accompanied by a wagon in the fighting line. Therefore it is no longer necessary to carry a complete detachment on the gun, and the men can be divided between the gun and the wagon. Thus the French carry three men on each limber, besides the mounted gun-commander (*chef de pièce*). The Germans carry, in addition, two men on axletree seats; but in most modern equipments these are provided as emergency seats only. Our own limbers are seated for three men, but we usually carry only two men on the gun limber, two on the wagon limber, and one on the wagon body, besides No. 1 and No. 10 (the coverer, who rides with the wagon) on their horses. In addition to these we carry three men on the first-line wagon; these are sent up from the wagon line if required, after the battery has come into action.

MECHANICAL TRACTION.

Presumably, in course of time, guns will be drawn by motor tractors instead of horses. In fact this method of transport is already used on the Continent for the conveyance of heavy howitzers, whose great range renders it unnecessary for them to go off the

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road to find a position. But for field guns the present form of wheeled tractor is altogether unsuitable. Even if an independent drive be fitted to the fore and hind wheels, the motor is limited to sound and moderately smooth ground. In soft ground it sinks and becomes helpless, and a very small obstacle in the shape of a wall, hedge or ditch is sufficient to stop it.

Two forms of tractor, which may possibly be developed so as to render them suitable for military purposes, are shown in Fig. 44 and Fig. 45.

The "Caterpillar," made by Messrs. Hornsby of Grantham, is a wheel-less tractor running on an endless chain of blocks on either side. The two chains are connected by a differential so that they can be driven at different rates in order to steer round a corner. The tractor is driven by a 70 H.P. paraffin motor, and has four forward speeds, ranging from 1¼ to 7 miles an hour, and one reverse speed. Its cross-country powers are very remarkable. It goes over heavy plough with ease: it will take ditches five feet wide, and will go through any ordinary fence or hedge. Owing to the large bearing surface afforded by the blocks, it is not liable to sink in soft ground. Its peculiar method of surmounting an obstacle is shown in the figure, which is taken from a photograph. The Caterpillar, when it encounters a bank, rears itself high in air, climbs up it, and then runs down the other side. It has been known to go up a bank 12 feet high at a slope of 1 in 2. If it fails to pull the gun over the bank it goes on alone, puts on

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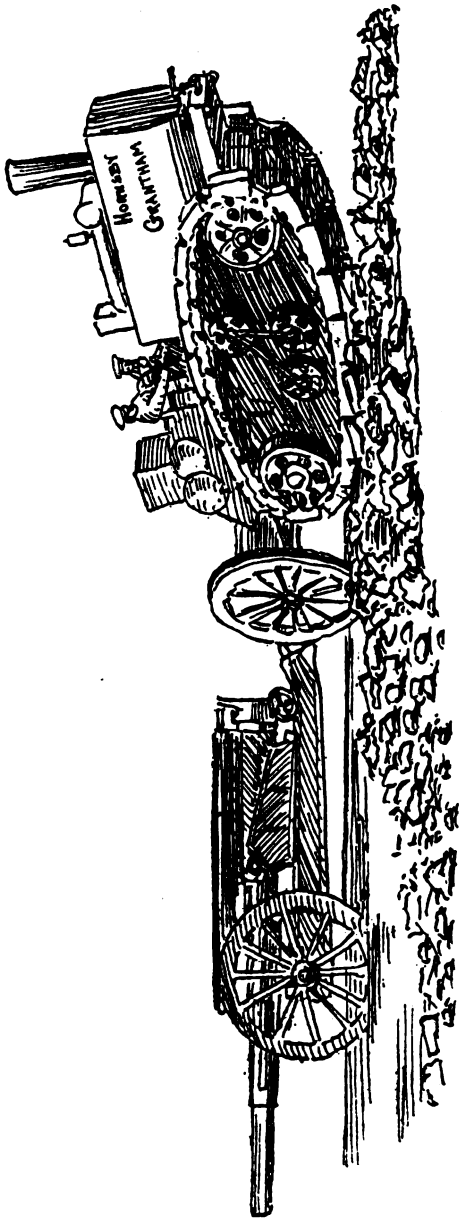

FIG. 44.—THE CATERPILLAR TAKING 60 PR. GUN INTO ACTION.

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the brakes, and then hauls the gun over with a wire rope and drum.

The Hornsby Chain Track Tractor, as the Caterpillar is properly called, weighs 8 tons complete, and will haul a load of 5 tons across country or on the road. In spite of its nominal seven miles an hour speed, it is a slow tractor. When pulling a 60 pr. gun it is incapable of keeping up with a column of infantry on a moderately hilly road. But it is understood that the Caterpillar is now being improved so as to take a 60 pr. up any ordinary hill at 4 miles an hour, and it would appear possible to provide a lighter and faster type for field artillery wagons if required. For the first-line wagons, a suitable tractor would be one capable of pulling two 40 cwt. wagons at 12 miles an hour on the level road, and 6 miles up a gradient of 1 in 10. For the brigade ammunition column, it should pull two 3 ton (gross) trucks at 8 miles an hour on the level, and at 4 miles an hour on a gradient of 1 in 10. For the divisional ammunition column, a heavier tractor would be required, to pull three 6 ton (gross) trucks at 5 miles an hour on the level, and 3½ miles on a 1 in 10 gradient. This tractor would also be suitable for the second echelon of the second-line transport, the first echelon being equipped with motor lorries.

If the Caterpillar tractor were ever developed so as to take a field gun into action, it would have to be a comparatively small machine, able to pull a 25 cwt. gun at 12 miles an hour on the level road, 8 miles up 1 in 10, and 8 miles over stubble fields or similar ground.

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Mr. Diplock's Pedrail, illustrated in Fig. 45, is another invention which may possibly be developed as an artillery tractor. Its external appearance is that of a traction engine with elephant feet on the wheels. The action is, however, quite different from that of a traction engine, as the weight is not carried upon the naves of the wheels but by a fixed rail which glides along rollers attached to the feet.

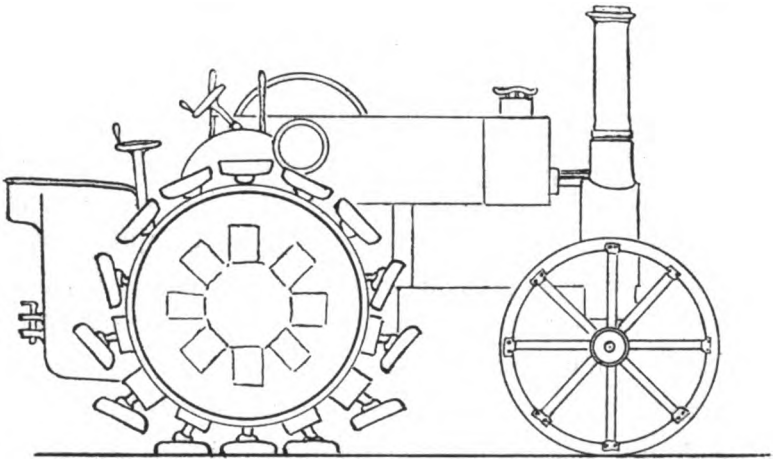

Fig. 45.

The Pedrail is not exactly a cross-country machine, but it is remarkably efficient on very bad roads, and especially on soft ground in which an ordinary tractor would get bogged. It has the peculiar property of improving the road surface instead of breaking it up. With ordinary tractors the wheels slip when the slope becomes too steep, but with the Pedrail the hauling power is only limited by the power of the engine, as the feet afford a firm grip. The Pedrail weighs 6 tons and hauls a load of 15 tons gross at about five

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miles an hour. It seems well suited to the divisional ammunition column and second-line transport, especially in countries where the roads are bad, such as the Balkans. It does not appear probable that the Pedrail will ever be developed as a tractor for use in the fighting line.

The **Renard Road Train** has a universal-jointed shaft extending the whole length of the train, which drives every pair of wheels in the train by bevel gearing. It does very good work on the road, but does not appear suitable for travelling across country. In the writer's opinion this system is inferior to the **electric road train,** in which each wheel is driven by its own motor, the current being supplied by an engine and dynamo on the leading carriage. The expense and complication of the gear at present stand in the way of the adoption of the electric system.

The **Freibahn Road Train** consists entirely of two-wheeled vehicles, coupled together in pairs so as to make flexible units. The advantage of this is that, as the wheels do not have to lock under the trucks, very large wheels can be used, as much as 6 feet in diameter. This is of great assistance in travelling over bad roads.

Motor traction for ammunition columns is already coming into use, and in Germany the divisional ammunition park is conveyed in road trains. The next step in advance will be motor traction for divisional ammunition columns (probably road trains). Then will come motor wagons for the brigade

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ammunition column, then for the first-line wagons, and finally we shall have motor tractors for the fighting-line wagons and even for the guns.

A compromise which has many advantages is the following: The guns and the wagon bodies are drawn by road tractors, and the gun limbers by teams. There are no wagon limbers. The tractors also carry 100 rounds of ammunition per gun, and so replace the first-line wagons. The battery, in this formation, should be able to reach a point within half a mile of the position by road. The gun limbers then limber up the wagon bodies, with the guns behind them, and take them both into position; or if the ground is too steep or heavy for this they make two trips, first taking up the guns, leaving the limber ammunition on the ground with the guns, and then fetching the wagon bodies.

Mechanical traction has two great advantages, besides economy. The first is the facility with which ammunition can be replenished; the second is the reduction in the length of the column. As regards the first point, when the horses are tired out after a battle the motor wagon can go off 25 miles to rail-head to replenish, and be back by daylight next morning. As regards length of column, road train transport, with motor wagons in the first or light echelon, occupies about one-fifth of the road space required by horsed wagon transport. Thus for an army corps of two divisions and a cavalry brigade, the ammunition parks and columns occupy 9 miles 6 furlongs of road, allowing 25 per cent. for opening

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out, whereas with mechanical transport, making the same allowance, the road space will be just under two miles.

From the administrative point of view, the introduction of motor traction on a large scale is inevitable. For no country can afford to keep up either horse or motor transport in peace time for its ammunition columns, and these will be dependent upon horses or motors hired or purchased on the outbreak of war. And since the motor is steadily replacing the horse for all heavy and medium civilian transport, the number of cart horses and van horses available on mobilization will be insufficient to cover the military demand.

In our own service, the great obstacle to the introduction of motor transport is the unknown destination of the expeditionary force. Thus motor wagons would be useless on the Indian frontier or in the Balkans, and nearly so in Natal.

Type of Motor.

Setting aside special military motors, which hardly exist at present, the motor transport employed by artillery in the field will be that in general use in the country. The type of this is determined by economical considerations. But a far-seeing Government can do much to cultivate the development of a type suitable to military purposes. Thus the German Government pay a subsidy (stated to be 10 per cent. on cost price) to the purchaser of a tractor or motor lorry passed fit for army use. The principal

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requirement, from a military point of view, is that the motor should use fuel obtainable in the country, and preference is accordingly given to motors running on heavy oil, such as shale oil or tar oil. For traction engines, steam motors using coke or coal are preferred. It must be remembered that the supply of petrol is practically confined to America and S.E. Russia, and that petrol will certainly be made contraband of war. It is calculated that, owing to expense of storage, there is not a week's supply of petrol in any country of Western Europe, so that the blockade of the land and sea frontiers would render all the petrol cars in the country useless.

A very desirable feature, in a motor tractor or lorry intended for military purposes, is an independent drive to the fore and hind wheels. This enables the vehicle to leave the road for a short distance, as, for instance, to camp in a field by the roadside. Failing the independent drive, at least a means of locking the differential must be provided. Without this, if one wheel sinks, the other revolves helplessly in the air.

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CHAPTER VIII.

ARMS AND STORES.

ARMS.

In our own artillery these are limited to 36 rifles per battery, of which 3 are carried by the battery commander's staff, 24 on the limbers, and 9 by the dismounted men with the second-line transport. Officers carry revolvers. In most foreign armies every man of the battery is armed either with carbine or automatic pistol. These are not intended for use when the battery is in action, but for protection in billets or bivouac, on the march, and in case the wagon line is attacked by cavalry.

TELEPHONE AND OBSERVATION WAGONS.

Each brigade of 3 batteries, and each heavy battery, has a telephone wagon. This, in our service, is a light two-horse wagon carrying drums for laying field cable, with gear by which the drums are revolved for picking it up. Light poles and a ladder are carried for making overhead crossings across roads, otherwise the cable is laid on the ground. The limber carries telephones and stores.

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In foreign armies the telephone wagon is combined with an **observation wagon** drawn by four horses. This carries a ladder with supports, similar to a photographer's ladder (see *Observation Stores*), and the signalling, laying and telephone stores. This system appears inferior to our own, since, if the wagon is sent off to lay cable before the batteries come up, it takes the whole of the other stores with it.

SPECIAL ARTILLERY STORES.

These comprise stores for observation, communication, laying, range-finding, and fuze-setting.

Observation Stores.

These include field glasses, telescopes, and the observation ladder.

The **brigade commander's ladder** is carried, in foreign armies, on the observation wagon. It is a telescopic or jointed ladder about 16 feet high, supported by props and steadied by guys. At the top is a seat and a table, with socket for the director telescope, which is usually a panorama telescope as described under *Sights*. A shield for the observer is sometimes provided. The object of the ladder is to obtain a view over high cultivation, such as hops or vines, and over undulations of the ground, without having recourse to a high hilltop which would form a natural target for the enemy. Moreover, on a crowded battlefield convenient hilltops are not available in sufficient numbers for all the staffs.

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The **battery observation ladder** is either part of an ammunition wagon, or carried on it. The commonest form is a shielded prolongation of the perch of the wagon body, which is tipped so that the perch is raised into the air.

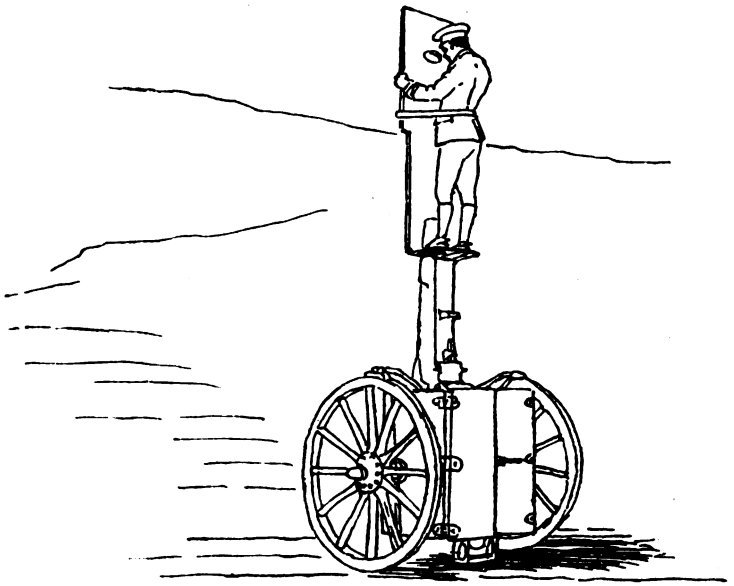

FIG. 46.—ARMSTRONG FIELD OBSERVATORY.

The shield, when not in use for observation, is laid across the tops of the opened doors of the wagon body, so as to give overhead cover. With non-tipping wagons, the ladder is erected on top of the wagon body, and the shield is the rear door of the wagon body or limber, removed from its hinges. The object of the battery observation ladder is to enable the battery commander to observe from a point as close as possible to his guns, when these are in the concealed or semi-concealed position.

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Communication Stores.

These comprise flags, telephones, heliographs, lamps, and megaphones. In a howitzer battery especially, which makes great use of the concealed position, it is important to have a number of men expert in the use of each and all of these means of communication.

For ordinary short-distance communication, **semaphore** signalling is excellent, as a man can signal with his arms without attracting the enemy's attention by waving a flag. For longer distances the **Morse** code is used. The normal means of communication between the observing position and the battery is, in most armies, the **telephone**, as this involves the minimum of exposure to the operators. Two mounted men in each battery carry telephones and reels of light cable; in our own army this is reeled up after use, but foreign armies mostly use light wire which is left on the ground. The brigade commander's telephone cable is more substantial, and is carried on drums on a cable wagon. Some armies, such as the Italian, use a telephone equipment carried on pack horses. Telephones are always liable to break down, either from the cable being broken by other troops, from wet weather affecting the instruments, or from other causes. It is a rule in our own artillery that every telephonist must be a signaller, and be ready to pick up his flags if his telephone fails. **Heliograph signalling**, when the weather allows of it, is quicker than the flag, and is invisible to the enemy unless he is in line with the receiving

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station, or nearly so. The **lamp** is of great use at night, and powerful acetylene lamps are now made which can be used even by daylight.

The **megaphone** is useful at short distances, but is bulky to carry, and no really satisfactory portable megaphone has yet been devised.

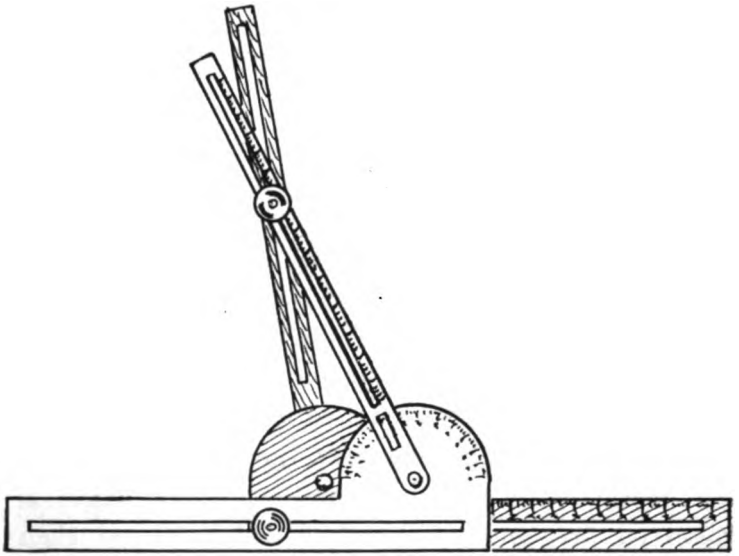

Fig. 47.

Laying Stores.

These comprise the directors and the plotter, and the aiming posts. Their use is described under *Laying*. The **director** is in effect a theodolite, and consists of a sighting telescope pivoted on a horizontal graduated circle with tripod stand. It is also fitted to take a compass.

The **plotter** is a simple instrument for solving triangles.

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It consists of two arms pivoted on graduated circles separated by a base-bar, which can be set to any required length. If this be set to the base, and one arm to the range and included angle, then the third side of the triangle and the angle at the other end of the base can be read on the reverse side of the instrument.

Aiming posts are light steel pickets used for marking the line of fire.

The Rangefinder.

Rangefinders are of two kinds, the "two-man" and the "one-man" type. In either case the range is found by triangulation, the angles to an object being taken from the ends of a known base. With the **mekometer** used in our own service, the base is a cord stretched between two instruments, held by two men. With the **telemeter**, the ends of the base are marked by tripod pickets, and the angle is observed first from one end of the base and then from the other, one angle being always a right angle.

In **one-man rangefinders** the base is a bar from 3 to 5 feet long, rigid or folding. The object glass of a telescope is set at each end, the rays being reflected to a central eye-piece. To take the range, the telescopes are directed on a well-defined object and one telescope is inclined inwards by turning a drum till the two images formed in the central eye-piece coincide. The range is then read on the drum. In some instruments, such as the Zeiss, one image is inverted to facilitate bringing them into coincidence. **Stereoscopic**

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rangefinders have also been tried; these depend on the stereoscopic effect produced by separating the two object glasses. They require good eyesight to use them. These short-base rangefinders are sufficiently accurate for artillery purposes, but are delicate and require frequent adjustment. They are much quicker in use than the two-man instruments, and have this great advantage, that the range can be taken by one man lying down, whereas the two men working a long-base instrument are nearly always obliged to expose themselves.

The Fuze Corrector.

The time fuze is graduated so that when set to the graduation corresponding to the range it bursts the shell at the target. The time of burning of the fuze is, however, affected by atmospheric influences, and moreover, it is necessary to adjust the fuze to give high or low bursts as required. For this purpose the fuze corrector is used. In its ordinary form it consists of a dial on which the ranges are marked, with an inner dial graduated to match the graduations of fuze. The inner dial can be shifted with respect to the outer, the distance through which it is shifted being read on a graduated scale called the **corrector** scale. In our service the scale has 300 divisions, the normal setting being at 200. Before setting his fuze, the fuze-setter looks at the dial, then sets his fuze at the figure opposite to the range which has been ordered. If the battery commander finds that his fuzes are burning too short, and bursting the shrapnel too

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high, he lengthens the corrector, ordering the inner dial to be set at, say, 210 instead of the normal 200. The dial is so graduated that a given alteration of corrector shifts the point of burst by a proportionate amount at all ranges, so that if the corrector setting be found for any one range, this will give an effective fuze at any range, so long as the atmospheric conditions do not vary.

The Automatic Fuze-Key.

This is used to set a number of time fuzes at the same graduation. It consists of a cup fitting over the head of the shell, having a catch which engages in a recess in the body of the fuze, and a stop which engages with a stud on the time ring. If the cup be set on the head of the shell and turned round, then the time ring will be shifted to a graduation corresponding to the distance apart of the catch and the stop. This distance can be varied as desired, the key being set by a range scale and corrector scale marked on the outside, and clamped before use.

The Fuze-Setting Machine.

This is similar in principle to the automatic fuze-key. It is fixed to the lower door of the wagon body so as to rest on the ground, and has a cup into which the fuzed shell can be inserted point downwards. By turning a handle the fuze can then be set as with the automatic fuze-key. The French fuze-setting machine takes two shell at a time. If the machine is to be constructed so that the same corrector setting is

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applicable to all ranges, this involves a considerable increase of complication. The fuze-setting machines used by most Continental armies have therefore no differential corrector scale, but the machine is simply arranged to set fuzes at any graduation that may be ordered.

The Schneider fuze-setter is shown in the annexed figure. It has a pin which fits into a recess in the nose of the fuze, in order to ensure correct centring.

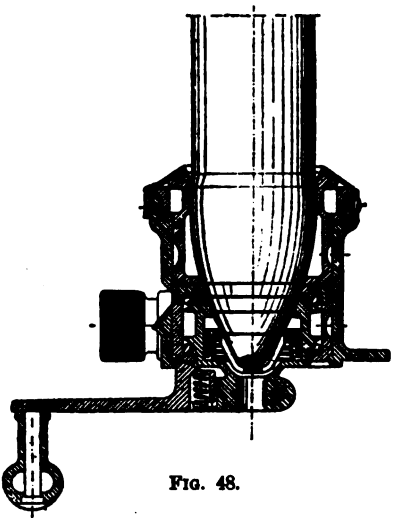

FIG. 48.

TOOLS, IMPLEMENTS, AND MISCELLANEOUS STORES.

The fighting battery carries the following: Entrenching tools (usually a pick and shovel to each carriage), bill-hooks, saws, felling-axes, and drag-ropes; spare parts of equipment, such as sights and the smaller parts of the breech mechanism; blankets, grease, oil and cleaning stores; and spare harness. The saddler, shoeing-smith, and farrier have each a wallet containing a few tools and stores for immediate requirements. These stores are divided between the gun limbers and ammunition wagons, the heavier articles being on the latter. Telescopes, rangefinders, directors, plotters, and telephones are carried by the

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mounted men. Each man carries on his person a clasp-knife, water-bottle, haversack, and field dressing; on his saddle, or on his seat on the limber or wagon, he carries a mess-tin, greatcoat, blanket, waterproof sheet, and a few articles such as a spare shirt and socks and a spoon.

SECOND-LINE TRANSPORT.

Besides the baggage of officers and men, a battery takes into the field spare rations and forage, tents when ordered, picketing gear for the horses, blankets and waterproof sheets for the men, a field forge for shoeing and repair of equipment, spare horse-shoes, spare clothing, spare parts of equipment other than those carried in the fighting line, veterinary stores, and tools and materials for the saddler, wheeler, carriage-smith, tailor, and farrier. Certain of the stores used in the fighting line, such as signalling lamps, are carried in the second line until likely to be used.

In our own service the whole of the second-line stores are carried in G.S. (General Service) wagons. The present pattern of G.S. wagon is a four-wheeled vehicle without springs, capable of carrying about 30 cwt. The fore and hind axles are connected by a perch capable of twisting in its socket so as to allow a certain amount of flexibility on rough ground. Since there is no weight on the horses' necks, these wagons travel better on the road than flexible limbered wagons.

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In large armies, owing to the difficulty in procuring a sufficient supply of horses, these transport wagons are steadily being replaced by motor wagons for the first echelon of the transport, and trains of road trucks drawn by traction engines for the second or heavier echelon. This also applies to divisional ammunition columns.

Foreign armies, in addition to transport wagons, use a variety of special limbered wagons, such as field forges and store wagons. **Field kitchens** are now used in Russia, Germany, and Austria. A field kitchen is a limbered vehicle drawn by two horses, the limber being fitted to carry rations, while the body is a stove capable of cooking on the move for one battery.

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PART II.

PRACTICAL GUNNERY.

CHAPTER IX.

FIELD ARTILLERY FIRE.

THREE natures of fire are used in the field, namely **gun shrapnel fire**, **howitzer shrapnel fire**, and **high-explosive shell fire.** When the latter shell are not available, **percussion shrapnel fire** is used as a substitute.

Gun Shrapnel Fire.

The object of the designer of the gun and ammunition is to obtain a dense shower of bullets flying forward as nearly parallel to the ground as possible, in order to cover a great depth of ground. The *dangerous zone* of each bullet is increased to the utmost, in order that if it just misses the head of a man at *a* it may still hit the foot of the man at *b*, 50 yards behind him; and so on. The advantage of a deep dangerous zone, at a fixed target, is to allow the gunner more latitude. For it will never be possible to find the range exactly; the trajectories of the shell fired at the same elevation will not all pass

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through the target; and the fuzes will not all burst the shell at the exact point intended. The more ground effectively covered by the sheaf of bullets, the less will these sources of error detract from the effect.

A deep zone of shrapnel effect is obtained by making the trajectory as flat as possible; this requires

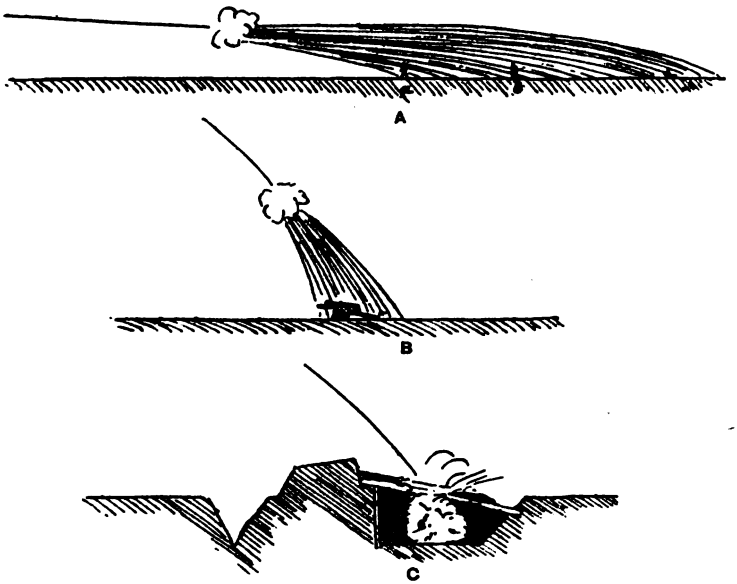

Fig. 49.

a high muzzle velocity, and the limit in this direction is the weight of the gun. The velocity of the bullets is increased by the use of a **base burster** in the shrapnel, which adds from 150 to 200 f.s. to the bullet-velocity due to the remaining velocity of the shell. The weight of the bullets is a difficult matter to decide, since if made too light they will lose their effective velocity after travelling a short

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distance, while if too heavy the number of bullets in the shell will be reduced. This difficulty may be met in two different ways. In France, the field gun has a flat trajectory, giving the shell a high remaining velocity, and full advantage has been taken of this by using a large bullet (38 to the pound) which enables the shrapnel burst to cover a depth of 300 metres of ground. In Germany, the converted field gun is a weak gun with a curved trajectory, giving a comparatively small danger zone. Accordingly the Germans use a small bullet (45 to the pound) in order to get as many as possible into the shell, and increase the number of hits; while they endeavour to compensate for the small depth of ground covered, by firing at two or more elevations instead of one; thus a German battery, having found the range as 3500 metres, fires alternately at 3450, 3500, and 3550.

Our own field gun gives a velocity and angle of descent intermediate between those obtained with the French and German guns, and accordingly we use a bullet of 42 to the pound, intermediate between the two.

It is the business of the battery officer to suit his procedure to the peculiarities of his gun, so as to produce the best effect. Having found his range and fuze, as described in the next chapter, he must adjust the length of fuze to suit the gun, ammunition, and target.

Theoretically the best distance from the target at which to burst the shrapnel is that which affords one

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bullet, neither more nor less, for each man of the enemy. This distance depends on the target surface offered by each man; it is immaterial whether the men are shoulder to shoulder or in a thin skirmishing line. For practical purposes we may take the target surface of a man standing as $\frac{1}{2}$ square yard, kneeling $\frac{1}{3}$ square yard, and lying $\frac{1}{4}$ square yard, measured at right angles to the trajectory. If there are 300 bullets in a 16 pr. shrapnel, and the angle of the cone be 1 in 4, then for firing at men standing the cross-section of the cone should be 150 square yards, at men kneeling 100 square yards, and at men lying at 75 square yards, which fixes the proper distance of the point of burst from the target at 52 yards, 44 and 40 yards respectively, so that we see that the less target each man exposes the closer up should the shrapnel be burst, irrespective of whether the men are one yard apart or ten.

In practice it is quite impossible to observe the distance from the target at which the shrapnel bursts; we can only observe the height.

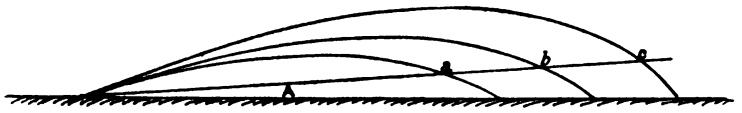

FIG. 50.

Now if we take any given distance, say 50 yards, as the correct distance short, and if in the figure we measure up 50 yards along the trajectory at a number of different ranges, to the points *a*, *b*, and *c*, we shall find that these points, as seen from the gun, are

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practically in the same straight line. If, therefore, we measure the angle A, and find it to be, say, 15 minutes, then if we elevate the sighting telescope or director telescope 15 minutes above the target, any bursts which appear on the cross wires will be at the correct distance from the target.

In fixing the proper distance of the burst, and thence the angle A, for any gun, regard must also be had to the mean error of the fuze. This subject involves the Theory of Probabilities, and cannot be adequately dealt with in the present work. But it is clear that if shrapnel fuzed alike burst at distances varying by as much as 150 yards, then if we fix the mean distance from the target at only 50 yards, a good many of the shrapnel will burst on graze, and will be practically ineffective. For this reason, in the 18 pr., the angle A, called the **angle of height of burst**, has been fixed at 15 minutes, corresponding to a distance of about 90 yards from the target, measured along the trajectory. This height is found to give 10 per cent. of bursts on graze; if the shrapnel are burst higher the bullets will be too much scattered, and "the pattern will be too open"; if burst lower, then too many shrapnel will be wasted by bursting on graze.

When firing at **shielded guns**, the bullets of gun shrapnel are ineffective at men behind the shields, and bursts in air are only useful for sweeping the intervals between the guns, and the ground behind the battery, with bullets, so as to make the men keep close behind their shields. Shrapnel effect on a

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shielded gun can only be produced by making a direct hit on it. If the shell strikes the gun or any solid part of the carriage it will disable it, and the bullets will scatter among the detachment. If the shell strikes the shield it will make a small hole and will burst from two to three yards beyond; the No. 1 at the point of the trail will probably be killed, and also the section commander, but men close behind the shield will not suffer unless in the path of the shell. At shielded guns the fuze is lengthened, by the use of the corrector scale, till it gives about 75 per cent. of percussion bursts and 25 per cent. of bursts in air. It must be remembered that a shell bursting after passing through a gun-shield will appear to be "over."

So far we have only considered the effect on fixed targets. When the target is moving, or when the target consists of an area of ground thinly covered with men in successive skirmishing lines or scattered formations, then the depth of the zone of bullet effect is of great importance. If we range accurately on any part of a deep target, the men beyond the distance covered by the bullets will escape; if we cover a deep area by "searching" (see *Fire Discipline*) we shall expend a great deal of ammunition for a small result. Therefore for a deep target we require a deep zone of shrapnel effect.

The depth of the zone may be increased by bursting the shrapnel higher than usual, so as to make the bullets carry further. But this increased depth is obtained at the expense of effect on the men in

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the front line, which it is especially important to produce.

A deep bullet-zone means a flat trajectory, requiring a high velocity, and therefore a heavy gun. It also means a heavy bullet, reducing the number of bullets in the shrapnel. Therefore it is not surprising that opinions differ considerably on this point. The Germans, for instance, consider that we are misled by our experience on the open veldt of South Africa into believing that attacks will always be carried out in very thin and very deep formations. They hold that in a close country the firing lines will be dense, and therefore they sacrifice depth of effect in order to get a large number of small bullets into their shrapnel, giving an increased effect on the enemy's front line. But it must be remembered that the German converted 15 pr. is a low-velocity gun (M.V. 1525 f.s.), and is incapable of any great depth of effect. The French have always been advocates of the far-reaching shrapnel. The Japanese, after the war, have adopted a heavy shrapnel bullet (36 to the pound) and a field gun giving the highest velocity compatible with moderate weight.

The shrapnel fire of the **heavy field gun** is especially effective, not only owing to the large number of bullets in the powerful shell, but owing to the flat trajectory and high remaining velocity, which renders the bullets effective at a quarter of a mile from the point of burst.

Field howitzers, when used as guns at low angles

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of elevation, produce good shrapnel effect at medium ranges, since each shell contains some 600 heavy bullets. The depth of effect is about half that of a field gun.

Percussion Shrapnel Fire.

When a shrapnel strikes the ground it either buries itself or it ricochets; in the latter case it turns upwards before it has time to burst, and the bullets go up in the air. By the time they come down again they are travelling so slowly as to be harmless. Therefore, unless burst under the feet of cavalry horses, percussion shrapnel are not likely to do much harm to troops in the open.

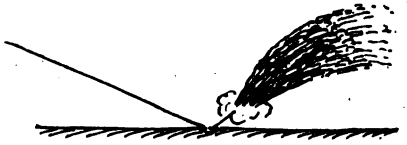

FIG. 51.

When the troops are in houses, behind garden walls, or behind thin parapets, percussion shrapnel is very effective against them. The powerful 18 pr. shrapnel will go through any ordinary wall, or through a 5 ft. parapet, and will burst in passing through, filling the space behind with bullets. Even the 13 pr. shrapnel will penetrate the wall of any ordinary house.

It used to be laid down that troops were safe from gun fire behind two walls, since the first wall would burst the shell and the second would stop the bullets and splinters. But there are so many window spaces and door spaces in the front of a house that a great

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many shell are likely to penetrate to the back wall before bursting. Moreover, if a house be fired at with the 18 pr. or the 4·5 in. howitzer, there will soon be very little left of the front wall.

Howitzer Shrapnel Fire (see Fig. 49, B).

The object of this nature of fire is shown by the figure; it is to reach troops behind cover such as gun-shields or parapets, or in deep trenches. The proper height of the burst is determined on the same principles as with gun shrapnel, and the angle of height of burst found most suitable is about 36 minutes. When burst at this height the bullets cover a space of ground about 70 yards deep by 35 yards wide, so that accurate ranging is required to bring the target within this area.

It is clear that the more nearly vertically the bullets strike downwards, the better will be the effect; accordingly howitzers and howitzer ammunition are designed so as to give an angle of descent of not less than 30° to the horizontal at all ranges over 2000 yards. If we add to this the semi-angle of opening of the shrapnel, we find that the lowest bullets strike downwards at an angle of about 40°, or more at high elevations. Unless a man be protected by a hooded gun-shield, he will have to crouch very close to escape being hit.

Howitzer Charges.

In order to obtain a good angle of descent at all ranges, a howitzer must have several different

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charges. For it is clear that a charge capable of carrying the shell 7000 yards at full elevation would only require a low angle of elevation to carry it 2000 yards, and would consequently give a low angle of descent at the latter range. A howitzer has therefore usually six charges. The full charge consists of six rings or biscuits, and the charge is reduced as required by withdrawing one or more biscuits from the cartridge case, which is separate from the shell. These charges are graduated so as

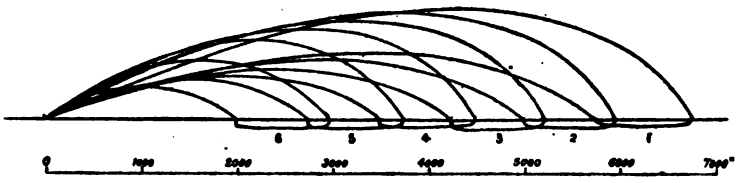

FIG. 52.

to give a certain overlap, so as to obviate the necessity of changing the charge during ranging, in case the range is found to be just beyond the limits within which a particular charge is laid down to be used. Thus, in Fig. 52, No. 1 charge gives an angle of descent of 45° at 6750 yards and 30° at 5750 yards; No. 2 gives 45° at 6000 yards and 30° at 5000 yards; and so on down to No. 6, which gives 45° at 3000 yards and 30° at 2000 yards. This is an ideal range table, and it is not possible in every case to arrange the charges in such symmetrical graduation, but the general principle of a good angle of descent and a good overlap is always maintained.

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A howitzer shrapnel travels at a comparatively low velocity, and, owing to the long time of flight, the fuze is less accurate than that of a gun shrapnel, so that the height of burst varies considerably. To compensate for these disadvantages a heavy bullet with a large burster behind it is used. In the light field howitzer shrapnel the bullet usually weighs 35 to the pound, and the burster is as much as ½ lb. of powder. In some Krupp equipments, and in heavy long-range howitzers, bullets of 16 to the pound are used.

Howitzer Percussion Shrapnel.

At troops in the open these are useless for effect, since the shell buries itself and the bullets remain in the hole. They are excellent for percussion ranging, as the large burster gives a conspicuous cloud of smoke. In the absence of lyddite or other high-explosive shell, they produce good effect against field overhead cover and at buildings, and the large burster has considerable incendiary effect. When firing at walls and buildings it is advisable to use the full charge, irrespective of angle of descent, in order to shorten the time of flight and so obtain increased accuracy and striking velocity. This also applies to percussion fire at shielded guns; but, generally speaking, better results will be obtained with howitzer time shrapnel fire than with howitzer percussion shrapnel fire when engaging artillery.

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High-Explosive Shell.

This is the ideal projectile for making direct hits on shielded guns. A percussion shrapnel, if it strikes the shield but not the gun or carriage, bursts several feet in rear, and is comparatively ineffective. But a H.E. shell, if it strikes any part of the equipment, detonates on impact. It disables the gun and possibly the wagon beside it, and kills the whole of the detachment. On the other hand, the effect against troops in the open is very slight, as the effect is only local, and, if the shell bursts on the ground, most of the splinters go up into the air. It is therefore a very open question whether field guns should carry high-explosive shell. Most foreign nations have decided in the affirmative, and carry from 15 to 30 per cent. of H.E. gun shell. We rely upon our powerful 18 pr. shrapnel, and expect to disable guns with it, even if it takes twice as many hits to do so as with H.E. shell. By this we simplify our ammunition supply, and are able to carry an increased number of shell which are effective against troops in the open.

With heavy field guns and with all natures of howitzers, field, mountain, and heavy, high-explosive shell are invaluable on account of their powerful breaching effect. When fitted with a delay action fuze, a field howitzer shell will go through about 5 feet of earth cover laid on a double layer of rails, and nothing stouter than this is likely to be met with in field works. In fact it may be said that no

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field work can be held for any length of time against howitzers firing H.E. shell.

The effect of a H.E. shell fired from a field howitzer at a strongly-built house is as follows: A large hole is made in the wall, the bricks and most of the splinters being blown inwards. Everything inside the room is destroyed, and many of the beams of the floor and ceiling are broken. The partition wall is pierced by fragments of shell. The slates fall from the roof in a shower, and after three or four rounds of this fire the floors and staircase fall in, and an ordinary ten-roomed house becomes unsafe to enter. If the house is lighted by gas, it will probably be set on fire, as the flash from the next shell will ignite the gas from the broken pipes; but otherwise the high-explosive burster has but little incendiary effect.

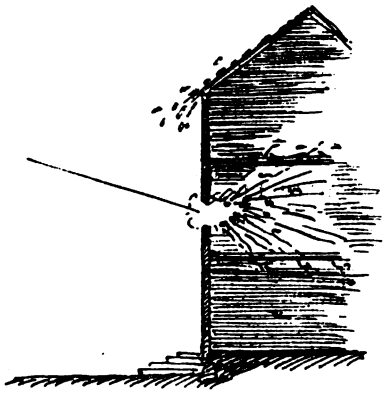

FIG. 53.

Effect on Ammunition Boxes.

When the present system of placing the wagon beside the gun was first introduced, some officers were inclined to condemn the folly of making a gunner crouch for protection behind a wagon-load of high explosives. Subsequent experience has shown

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that this criticism is unsound. It is by no means easy to blow up a modern cellular or honeycomb ammunition box. Unless the fuze in one of the shell be struck end on, there will be no explosion, and even then only the shell struck will explode. The ordinary effect of a direct hit on an ammunition box is to wreck it and scatter the shell and cartridges about; some of the cartridges may catch fire and blaze, but none will explode. It does not appear to matter very much whether the ammunition box be struck by a shrapnel or a high-explosive field-gun shell. But a powerful howitzer H.E. shell will send the fragments of the box and its contents flying in all directions with great violence, and is likely to cause considerable disturbance in the battery.

Accuracy of Fire.

The accuracy of a gun is expressed by the dimensions of the **sheaf of fire** described under *Ranging.*

FIG. 54.

Inaccuracy is produced by a number of minute causes; when these all happen to act in the same direction we get an erratic round; when, as usually happens, they more or less counteract each other, we get a fairly accurate round.

In practice it is found that with a field gun, at medium ranges, all the shell, including erratic rounds,

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fall within a space 120 yards long, while half the shell fall in a space only 30 yards long. These two spaces are called the 100 per cent. zone and 50 per cent. zone respectively. The range table of the gun gives the dimensions of the 50 per cent. zone, so that by referring to the range table the battery commander can tell the number of rounds likely to be required to hit a target of known dimensions, and so whether it is worth while to open fire on it. The width of the sheaf of fire is much less than its length, as the disturbing causes (such as jump of the carriage) affect the direction less than the range. Thus the 18 pr., for instance, will make one hit in four shots on a shielded gun at 3000 yards' range, after the range has been found. Most foreign guns are less accurate than this, but the 1910 Armstrong gun, firing pointed shell, is much more so, and will hit a gun at 3000 yards almost at every round. The 60 pr. heavy field gun, owing to its high velocity and heavy shell, is no less accurate than the Armstrong. At extreme range, over 6000 yards, most field guns shoot rather wildly; but this is only medium range for heavy field guns, and they maintain their accuracy of fire up to 8000 yards and over.

Field howitzers, both light and heavy, shoot very accurately in still weather. But there is nearly always a wind blowing in the upper regions of the air. The ordinary light field howitzer shell takes some 30 seconds to cover 5000 yards; the greatest height of the trajectory is four times the square of the time of flight, or 3600 feet, and at this altitude

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the wind is usually strong enough to blow the shell at least 100 yards out of its course.

Wind Corrections.

Many theoretical formulae have been calculated, which are supposed to give the exact allowance for a wind of given strength. In practice these are only useful as very rough first approximations. For the force and direction of the wind in the upper regions of the air cannot be determined with any approach to certainty from the conditions prevailing at the ground surface. Fortunately for the gunner, the higher winds are much less variable than the surface winds, and a correction based on the actual fall of the shell usually gives good results.

The question of **ranging** is discussed in the next chapter.

Oblique and Enfilade Fire.

It is clear that a gun-shield or parapet will afford less protection to men behind it when fired at

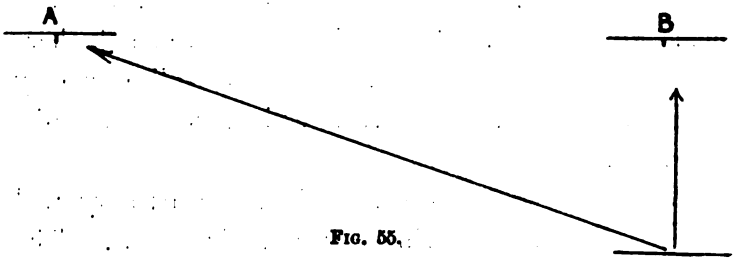

FIG. 55.

obliquely, and none at all when taken in flank. Therefore artillery should never miss a chance of using enfilade fire.

Thus of two targets, A and B, fire on B at 6000

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yards is likely to be more effective than fire on A at 3000.

The extent to which this nature of fire can be used on the battlefield depends upon the ground and on the perfection of the communications. Even in open ground affording a distant lateral view, it would be liable to create confusion if each battery fired at the target opposite to another battery. But when all are in communication with the C.R.A., he can allot the targets to the best advantage.

Firing over our own Troops.

In war, artillery will never hesitate to fire over their own infantry or over other guns. It is, however, not desirable to open fire when the infantry are too close to the muzzles, when this can be avoided, since a shrapnel bursting in the bore would do considerable damage to an infantry line only 300 yards to the front. This does not apply to howitzers, since the bullets from a premature go up in the air, and are not very dangerous when they come down again. As for high-explosive shell, there is no safety limit from these, as the splinters may fly a long way. This risk will have to be disregarded.

When our troops are attacking, our artillery will nearly always be firing over their heads. The distance from the enemy's line up to which it is *safe* to continue firing depends on the error of the gun and of the fuze, and is perhaps 200 or 300 yards; but this is immaterial, since if our guns

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cease fire when our infantry are still 300 yards from the enemy, they will suffer a great deal more from his fire than from possible short bursts. Practically, it may be laid down that our guns will continue to fire till our troops are within 100 yards of the enemy; the guns will not cease fire then, but will increase the range and fuze so that the shell are bursting over the enemy's line, where they are effective on reinforcements coming up. This is shown in Fig. 56.

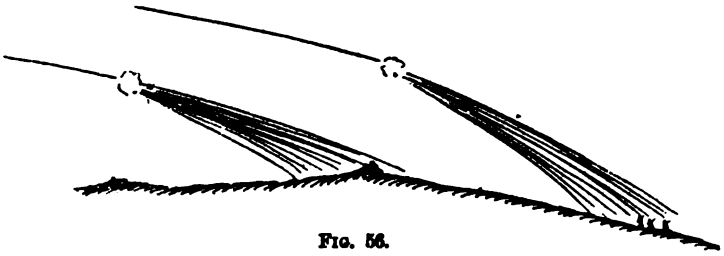

FIG. 56.

Field howitzers may continue to fire till our troops are within 50 yards of the enemy, unless the battery commander observes that some of his shell are bursting farther short.

Firing at Night.

This is of two kinds, according to whether the target is illuminated or no.

In the former case, the target is first located by the use of the searchlight or **concentrated beam**, which is a narrow pencil of intense light. When discovered, it is illuminated with the **dispersed beam**, which gives a more diffused light over a larger area. If possible, two dispersed beams are turned on the target from

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different directions. The two dispersed beams should be well to the flanks, or they will show up our own troops. It is impossible to see *through* the beam if it crosses between the battery and the target, and it is necessary that the artillery commander be in personal communication with the searchlight officer, who controls his lights by telephone or lamp. With two beams on a target distant 3500 yards, bursts short and over are clearly visible, and accurate ranging can be carried out either with time shrapnel or percussion. It is usually possible at night to push forward observing parties to within some 2000 yards of the target; when this can be done, ranging by electric light is easy.

At short ranges up to 2000 yards, **star shell** fired from howitzers may be used to illuminate the target. These must be burst high up so that the falling stars burn out before they reach the ground. If the stars set fire to grass or brushwood between the battery and the target, observation will be impossible till it has burned out.

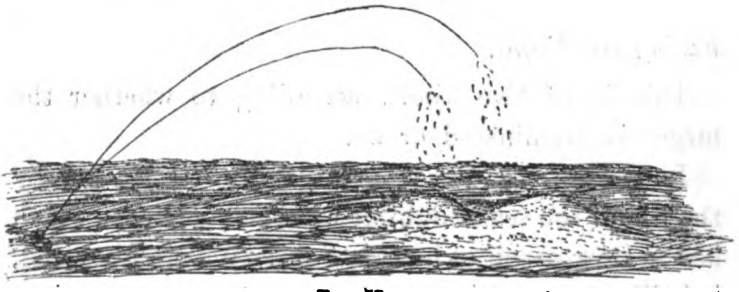

FIG. 57.

Stars falling behind the target will show up anything that may be on the sky line.

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Star-shell ranging is much more difficult than ranging by electric light. The best results are obtained by the method of cross observation described in the next chapter.

When the target is not illuminated, it cannot be ranged upon, and it can only be fired upon if it has been located by daylight. Cross observing stations are set up by daylight, and ranges and angles carefully measured. The bursts of the shell can then be marked down with the telescopes of the two directors, and the fire can be corrected as accurately as by daylight. But, of course, it will be impossible to discover whether any of the enemy are present at the point which is being fired upon, unless the flashes of their guns and rifles can be seen.

When a target has been fired upon by day, it is an easy matter to continue the fire by night. An aiming point about 300 yards distant is selected and marked with a lantern screened from the enemy. The sighting telescopes are directed on this point by day, and the angles recorded. But it must be remembered that there will be a certain "error of the night"; owing to the fall in temperature the powder will give a lower velocity, and the shell will range shorter than by day. It is therefore desirable to use the cross observation method to correct the fire.

The **tactical procedure** in night firing will be considered in Chapter XXVI.

Artillery fire at **air-craft** is dealt with in the next chapter.

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CHAPTER X.

FIRE DISCIPLINE.

THIS term is applied to the technical (as opposed to tactical) procedure of artillery in action. It embraces the formation and command of the brigade and battery, pointing out targets, laying, ranging, finding the fuze, fire for effect, observation of fire, replenishing ammunition, and replacing casualties, and also special subjects, such as fire from and at balloons.

Formation and Command.

The formation of a brigade in action in the open is shown in Fig. 58, that of each individual battery in Fig. 59.

The brigade commander meets the battery commanders at point P, on the left of Fig. 58, and points out their targets and positions. He gives them orders as to opening fire, and, if necessary, as to whether one battery only is to range for the brigade. The brigade then comes into action, as described under *Manœuvre*. Each battery commander then points out his target and opens fire. Further orders to the battery commanders are issued

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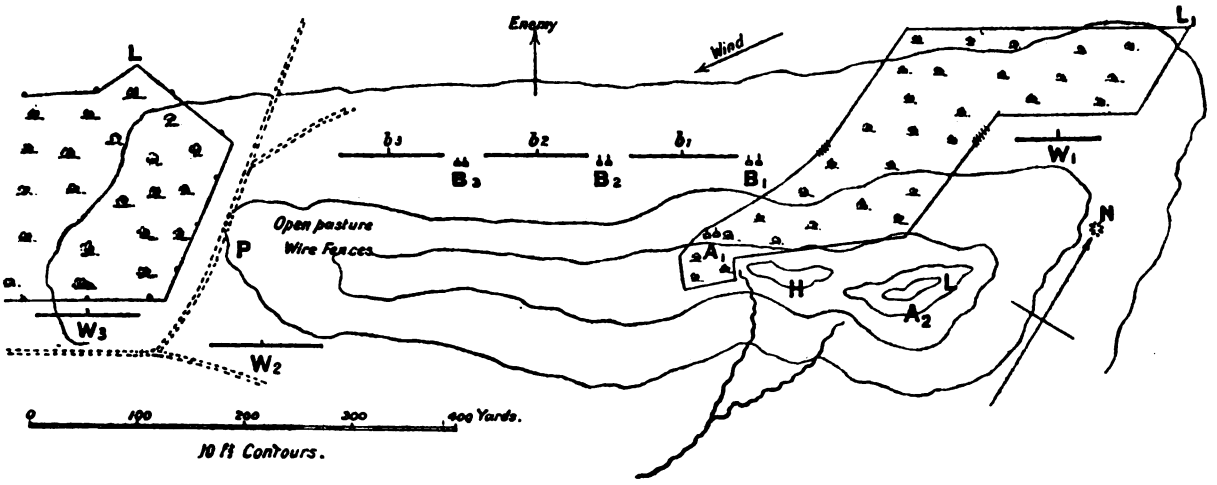

FIG. 58.—F.A. GUN BRIGADE IN ACTION IN THE OPEN.

A 1. Brigade commander, adjutant, brigade sergeant-major, and one orderly behind two gun limbers.

A 2. Remainder of brigade staff and brigade staff horses.

B 1, B 2, B 3. Battery commanders and staffs, each behind two wagon limbers.

b 1, *b* 2, *b* 3. Batteries.

H. Brigade heliograph in communication with C.R.A.

L 1. Look-out man from W 1.

W 1, W 2, W 3. Battery wagon lines.

LL. Look-out men furnished by flank batteries.

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through the adjutant, who has at his disposal three orderlies (see *Organization*) for this purpose. In this case one will suffice, as the adjutant can communicate with B 1 and B 2 by megaphone or voice. When communication by orderly is used, each battery commander has his own orderly standing (or lying) 20 yards behind him to receive messages.

In urgent cases the brigade commander, with the brigade sergeant-major behind him, marks for the

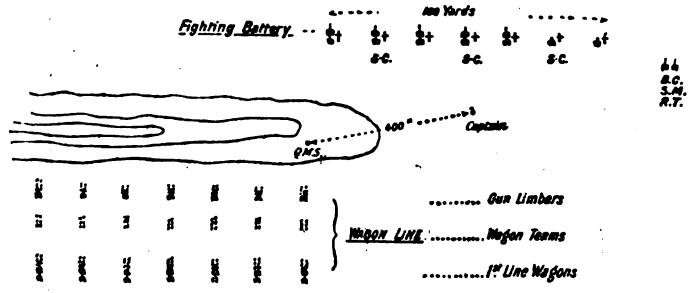

FIG. 59.—BATTERY IN ACTION IN THE OPEN.

centre of the position, and each battery commander as he arrives gallops up to him and receives his orders.

While the brigade commander is meeting the battery commanders, the adjutant makes arrangements to establish communication with the C.R.A. The orderly officer, when he has returned from guiding the batteries to the position, takes charge of communication with the C.R.A., with other commanders, and (usually) with any brigade patrols or advanced observing parties that may be employed.

The formation of a battery in action in the open is shown in Fig. 59. The battery is commanded by

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the major, who stands (or lies) to windward of the line of section commanders. When rapidity is essential he may stand in the centre of the battery. When on the flank, he gives his orders to the nearest section commander, who passes them on. The guns are normally empty; when the major gives out a range and fuze to the battery or to a

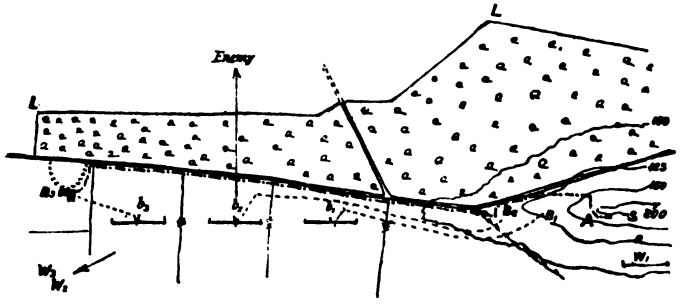

FIG. 60.—FIELD GUN BRIGADE IN ACTION, CONCEALED POSITION.

A. Brigade commander and staff. a. Brigade staff horses.
B1, B2, B3. Battery commanders and staffs. b1, b2, b3. Batteries.
W1, W2, W3. Battery wagon lines.
— · — · — · Brigade telephone cable. ------ Battery telephone cables.
S. Brigade signalling station in communication with C.R.A.
L, L. Look-out men furnished by flank batteries.

section, the guns are loaded and fired at the prescribed interval or at once. Usually the major ranges with one section, finds the fuze with the other two, and fires for effect with the whole battery.

The formation of a brigade in action in the **concealed position** is shown in Fig. 60. Two of the battery commanders are with the brigade commander, the third is in a house on the left flank, and the brigade telephone line is laid from the house to the brigade observing station. In this case the battery

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commanders meet the brigade commander at the brigade observing station to receive their orders.

Fig. 61 shows a **howitzer brigade** in action behind a railway embankment. The howitzers can get close behind steep cover, and the line of fire is not necessarily at right angles to the front.

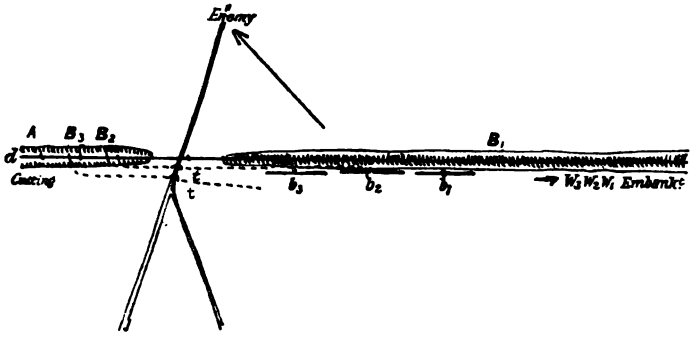

FIG. 61.—HOWITZER BRIGADE IN ACTION BEHIND RAILWAY EMBANKMENT.

A. Brigade commander and staff. a. Brigade staff horses.
B1, B2, B3. Battery commanders and staffs. b1, b2, b3. Batteries.
W1, W2, W3. Battery wagon lines.
Telephone from A to B1 connected to railway telegraph line.
Battery telephone cables buried at *tt*.

The formation of a battery in action in the concealed position is shown in Fig. 62. The battery telephone cable is led through the battery from the front, where it is less likely to be cut.

The major, from the observing position, sends all executive orders to the senior subaltern, called the battery leader, who falls out from his section, leaving the senior of the two Nos. 1 to command it, and takes post by the telephone or flag station in rear of the centre of the battery.

Both in the open and the concealed position, the captain superintends the replenishment of ammuni-

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tion and replacement of casualties, and his normal post is about 50 yards in rear of the centre of the

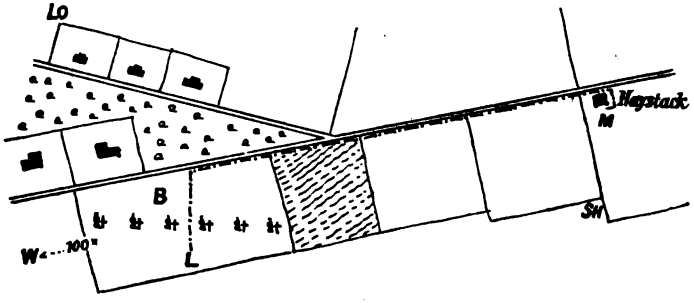

FIG. 62.—BATTERY IN ACTION, CONCEALED POSITION.

M. Major and staff.
B. Battery.
LO. Look-out man.
— · — · — · Telephone cable.
SH. Staff horses.
L. Battery leader.
W. Wagon line.

battery. He is in communication by signal with the Q.M. sergeant, who commands the wagon line.

Heavy Batteries.

The formation is the same as in a field gun battery, except that there are only four guns. There is a special observing party to each of the two sections, pushed as far as possible to the front. The battery has a telephone cable cart to assist in communicating with the observing parties. The work of both parties is superintended by the **observation officer**.

POINTING OUT TARGETS.

This is a difficult and important matter. If any officer or layer fails to locate the target correctly, the result is likely to be considerable waste of time and

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ammunition. A service target is not easy to distinguish in the confusion of the landscape. The best way to point it out is to align both a pair of aiming posts and the director telescope on it, and let officers and layers look over them. It is sometimes necessary to send an officer down the battery to lay each gun.

With fairly easy targets the clock code is used. The brigade or battery commander points out an unmistakably conspicuous feature (if he can find one) and indicates the target as "seven o'clock," or "three o'clock, two knuckles."

FIG. 63.

Thus, in Fig. 63, the reference point is the point of the lake. The battery at A is six o'clock, the signal station at B is nine o'clock two and a half knuckles, and the trench at C is half-past two o'clock one knuckle.

In the battery it is desirable when time permits to fall out the section commanders and layers to point out the target; when time presses, the target is roughly indicated by word of command, as "guns right front" and pointed out exactly to the commander of the ranging section; the remainder pick up the target by watching the bursts of the ranging shell.

In the brigade, one way is to send a rough panorama sketch (see *Reconnaissance*) to the battery,

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marking the target on it. When batteries are widely separated, and when time allows, each battery sends a panorama sketch in duplicate to the brigade commander. The adjutant letters these sketches to correspond with the brigade panorama sketch, keeps one copy, and returns the other. The battery can then be turned on to any target by signalling "Engage D," or other letter.

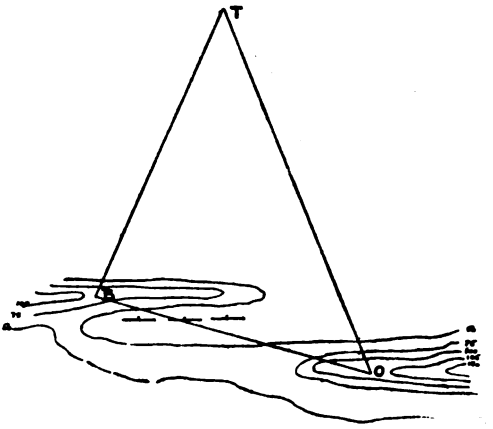

FIG. 64.

Another way is to use the brigade director and plotter. If, in Fig. 64, the adjutant works out the battery angle TBO and battery range BT to a target T, then to turn the battery on to that target it is only necessary to signal "Engage target angle 60 left of my director range 4200." Then the battery commander sets his director at 60, lays it on the brigade director, and when turned to zero it is pointing at the new target. This method is useful in the concealed position.

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In the defence of a prepared position, each battery has a carefully-prepared chart of the foreground, with ranges and angles of sight, and angles with reference to an auxiliary mark, entered on it. This chart is lettered to correspond with the chart of the C.R.A. or artillery commander of that section of the defence, so that the signal "Engage K" is sufficient to turn a battery on to a particular target.

LAYING.

Direct laying is a simple matter with modern sights. The layer sets his sight to the elevation ordered, and works the elevating and traversing wheels till the cross wires of his sighting telescope bear upon the target. Or, with the independent line of sight, he is spared the trouble of setting his sight for elevation; this is given by the elevating number on the other side of the gun. If one gun-wheel be higher than the other, this will make the shell deviate to the side of the lower wheel. With reciprocating sights this error is eliminated by bringing the sights into the vertical plane by the use of the cross-level attached to them; with other sights the correction is given by the gunner's rule:

"Multiply the number of inches difference of level by the number of degrees of elevation, and give this number of minutes of deflection towards the higher wheel."

The deflection to correct the fall of the shell is ordered by the section commander, or, in concealed

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positions, by the battery commander. It is arrived at by holding out a ruler or card marked in degrees at arm's length, and noting the number of degrees, or fraction of a degree, between the point of impact and the target. An even simpler method is to extend the fist and measure the deflection with one's knuckles, the angles subtended by which should be familiar to every officer. Occasionally it is useful to know that:

"One minute corresponds to an inch at 100 yards."

"One minute corresponds to a yard at 3600 yards."

Whence is derived the rule for giving deflection to correct the fall of a shell which is wide of the target:

"Reduce the error to inches, and divide by the number of hundreds of yards in the range."

INDIRECT LAYING.

This is used when the target is not visible from the gun, as in the concealed position. The gun is then layed for elevation by clinometer and range-drum, and for line by an aiming point. So far as the layer is concerned, he has only to set his dial sight to the graduation ordered, his clinometer to the angle of sight, and lay on the aiming point. With the independent line of sight the elevating number gives the elevation for the range as before.

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But before the layer gets his orders, the battery commander has to determine the line, the angle of sight, and the range.

FINDING THE LINE.

In the semi-concealed position, where a man standing on the carriage can see the target, the layer picks up his own line. When the target can be seen by standing on a limber run behind the gun, the line is given by the section commander. When the crest which conceals the guns is bare, without hedges, etc., to impede the view, two aiming posts on the crest can be aligned on the target. But in the ordinary concealed position the line has to be found by the battery commander, who uses one of several methods according to the ground.

(*a*) *Director and Aiming Posts.*

The battery commander aligns two aiming posts on the target, so that the line passes approximately through the centre of the position which the battery is to occupy. He sets up his director at o, behind them, in view of the guns, clamped at zero and with the object glass of the telescope towards the target. He aligns it on the aiming posts, clamps the base-plate, and then unclamps the graduated circle. He directs the eye-piece of the telescope at No. 1 gun, when it unlimbers, looking through the telescope the wrong way, or over the sights on top of it, and reads off the angle, say, 10° right.

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If No. 1 gun be now layed on the director with its dial or panorama sight set at 10° right, then its line

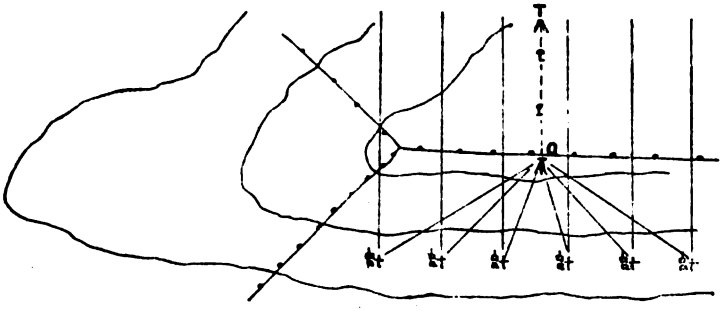

Fig. 65.

of fire will be parallel to the line of the aiming posts. Similarly each of the other guns is given its line.

(*b*) If the aiming posts and director have to be set up, say 300 yards to the left of the battery, then the

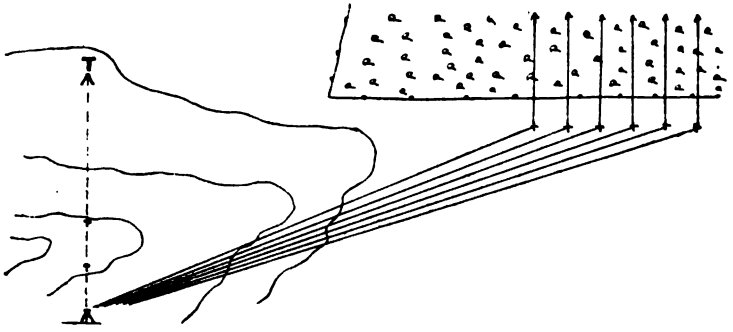

Fig. 66.

lines of fire of the six guns will be off the target to the right, as in the figure. In very easy cases this may be allowed for by aligning the aiming posts on a point 300 yards left of the target, but this method is subject to considerable error. Instead of this a

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displacement correction may be given from the following table:

DISPLACEMENT TABLE.

DISTANCE OF DIRECTOR FROM CENTRE OF BATTERY.

100 yards at		2000	yards'	range	-	-	-	3°
"	"	3000	"	"	-	-	-	2°
"	"	4000	"	"	-	-	-	1½°
"	"	5000	"	"	-	-	-	1¼°
"	"	6000	"	"	-	-	-	1°

Thus if the director is 400 yards left of the centre of the battery, and the range of the target is 3000 yards, the graduated circle is set at 8° left before it is clamped, so that the director when at zero points 400 yards left of the target.

(c) *Two Directors.*

It frequently happens that the battery commander's director cannot conveniently be set up in sight of the guns. In this case a second director is used, as in the figure.

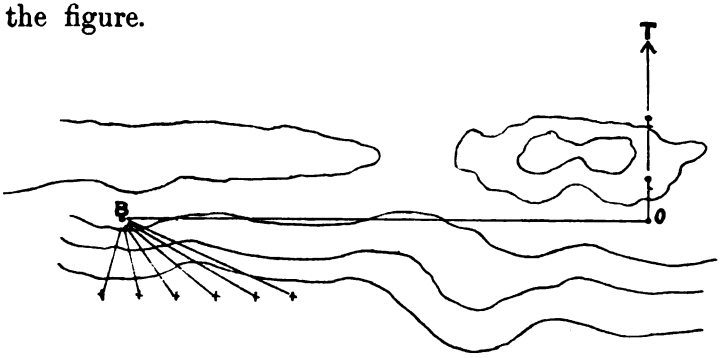

FIG. 67.

The battery commander, with his director, gives the line as in (*a*) to the battery leader with the

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second director, and he in turn gives the line to each gun. In this case the displacement correction is put on before giving the line to the second director.

(*d*) *The Plotter.*

Instead of calculating the displacement, it saves time in most cases to use the plotter illustrated in Fig. 47. This requires the range to be found or judged. Thus in the case illustrated in (*c*) the range-takers, before the battery comes up, take the range OT and the base OB, while the battery commander with his director measures the angle TOB. If the base-bar of the plotter be then set to the base, and one arm to the range OT and to the angle TOB, then when the plotter is turned over, the gun range BT and the "battery angle" TBO will be found on the other side. If the second director be now set at the battery angle and aligned on the first, then when turned to zero it will point at the target. When the guns come up, the line is given to each gun as in (*a*).

(*e*) *The Aiming Point.*

The layer, when his gun has got the line, turns his sighting telescope on to a convenient distant aiming point (usually selected by the battery leader) and records the angle in chalk on the trail. To direct the gun on the target at any time it is then only necessary to set the sight to this angle and to lay on the aiming point. When used in this manner the aiming point is called an **auxiliary mark**.

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It is sometimes convenient to order the guns to lay originally on an aiming point, instead of on the director; in this case the angle to the aiming point is first worked out with the plotter. In a concealed position it is the exception to find an aiming point available to the front, and a flank aiming point is usually chosen. Unless the aiming point be in prolongation of the front of the battery, each gun will require to lay on it at a different angle. If all are layed on it at the same angle, then if the aiming point be to the front the lines of fire will converge or even cross, or if to the rear they will diverge. To avoid the necessity for giving a correction to each gun in order to bring the lines of fire parallel, as they should originally be, it is advisable to use an aiming point in prolongation of the front.

THE ANGLE OF SIGHT.

This is the angle subtended by the height of the target above or below the gun.

FIG. 68.

If in Fig. 68 the target be 30 feet above the gun and 3600 yards distant, then, by the gunner's rule given above, the angle of sight will be

$$30 \times 12 \div 36 = 10 \text{ minutes},$$

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and if the sight be elevated 10 minutes by clinometer it will point at the target. If now the gun be given the elevation above the line of sight for 3600 yards, the shell should strike the target.[1]

In the concealed position the battery commander measures the angle of sight with his director. Having first found the battery angle referred to above, he inclines the graduated circle of his director, by laying

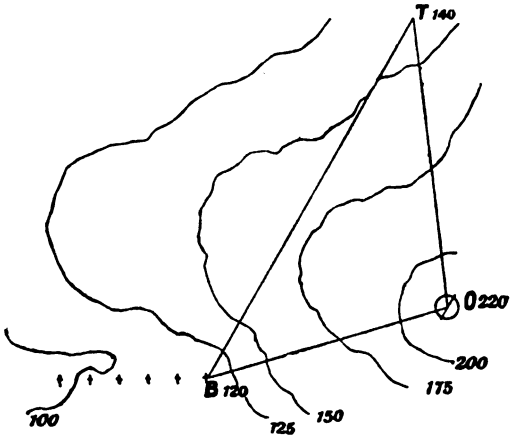

FIG. 69.

the sighting telescope first on the target and then on the battery, till the circle is in the plane of the three points T, O, B, the telescope, when at zero, pointing to the target.

Then if the telescope be set to the "vertex angle" BTO, it will be parallel to TB, and the angle of sight

[1] This assumes the principle of the "rigidity of the trajectory." It is practically true for field guns and approximately true for field howitzers, but is not true for high-angle guns such as balloon guns, in which the curve of the trajectory is appreciably affected by the angle of departure.

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can be read on the small clinometer attached to it. The vertex angle is obtained by subtracting the sum of the known angles TOB and TBO from 180°. This subtraction may be avoided by setting up the director clamped at zero and aligned on the battery, but it must be afterwards re-set, as the position of the zero constitutes a permanent record of the direction of the target.

If the battery and target can be located on a contoured map, this will give the angle of sight.

Use of the Dial Sight as a Director.

It must be remembered that each dial or panorama sight is a director in itself, and may be used for laying one gun parallel to another. This is often useful where some of the guns are out of sight of the director.

The Compass.

Two directors, though out of sight of each other, can be set parallel if each be set up so that the zero is to the North by the compass attached to it.

The Sun.

Similarly, if two directors be *simultaneously* aligned on the sun, moon, or a star, they will be parallel.

The Map.

If the battery, target, and observing position, or aiming point, can all be located on a large-scale

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map, the battery angle can be measured with a protractor. This is rarely possible with the half-inch to a mile maps used on service.

FINDING THE RANGE.

For the purpose of determining the line and angle of sight from a concealed position, the range may be judged, measured from the map, or taken by the rangetakers. The **gun range**, as distinguished from the range found from the observing position, is obtained with the plotter. In any case the range must afterwards be found and verified by the ranging process described in the next section.

RANGING.

The object of ranging is to find the elevation at which shells fired from a battery will strike the target. This elevation is not necessarily that corresponding to the distance of the target from the gun, according to the range table, because the strength of the powder is affected by the temperature and other causes, which together give rise to the "error of the day." Thus the correct sighting elevation for a target distant 4000 yards may prove to be 3900 on a hot day or 4100 on a cold one.

The process of ranging consists of finding two elevations at one of which shells burst beyond the target, while at the other they burst short. The difference between these two elevations is called the

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long bracket. This bracket is then subdivided by firing at intermediate elevations till a **short bracket** of 100 yards is found, and fire for effect is opened at the mean of the short bracket.

The range may be found by percussion ranging, when the shells are burst on the ground, or by time shrapnel ranging, when they are burst in air, or by a combination of the two.

Percussion Ranging.

When a number of shots are fired from a gun at the same elevation, they do not all fall at the same

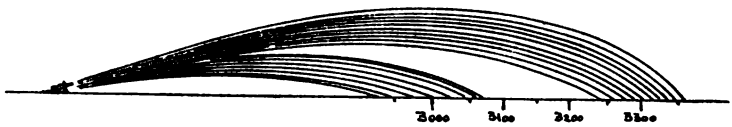

FIG. 70.

distance from the gun. At medium ranges they are spread over a distance of about 100 yards, being thickest in the centre of this area. When fired from several guns at the same elevation, the dispersion is increased about 25 per cent. The shells fired at each elevation form a **sheaf of fire**, as in Fig. 70. It is clear from the figure that the original elevations must be such that the sheaves of fire do not overlap, otherwise the battery commander might get a shell at, say, 3000 pitching over, and one at 3100 short, which would lead him to doubt the correctness of his observation. Further, it is desirable that the two sheaves of fire should each be clear of the target; thus, in the figure, if the target were at point 3050

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a shell fired at 3000 might pitch over it. Therefore in our own service we use a long bracket of 300 yards at medium ranges, and 600 at long ones. If the rangetakers take the range as 3750 yards, the battery commander orders "3600-3900." If he gets one shot over and one short (called a + and a −), then the target is **bracketed**, and the correct elevation should lie between 3600 and 3900 yards. The battery commander next orders "3700-3800." If these again give a bracket, the true elevation is probably between them; or if both over or both short, it is probably between one of them and one of the first pair. Thus, if 3700-3800 are both over, the true elevation is probably between 3600 and 3700, which gives the 100 yards bracket. To reduce the chance of error, this bracket is **verified** by firing one round at 3600 and one at 3700; if these again give a bracket, the target is almost certainly between them, and further corrections of 25 yards are made till an equal proportion of rounds are observed to burst over and short.

If the orginal pair of rounds had been observed both short, the battery commander would have tried a fresh pair at 3900-4200, or, if far short, 4200-4500.

If, during ranging, a round strikes the target, a pair of verifying rounds is immediately fired at that elevation.

A bracketing series of which only one round is over or only one short is unreliable, as this round may be at the extreme limit of the sheaf of fire, or may be wrongly observed.

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The following are instances of unreliable brackets. The signs refer to the B.C.'s observation. The sign (?) signifies "doubtful," and (T) target.

	3700 –	2900 –	4100 –
	4000 +	3200 T	4400 +
	3800 –	3200 –	4200 +
	3900 –	3200 ?	4300 +
	3900 –		4100 ?
	4000 ?		4200 +
Accepted range -	3950	3250	4150
True range -	4120	3370	3600

The most important matter is to obtain a reliable long bracket; this can then be subdivided as far as the conditions of observation permit.

In urgent cases, as when a favourable target presents itself for a short time, the endeavour should be to establish a long bracket with two shots, and then "jump" the range and fuze and open fire for effect. The alternative is the "searching" procedure described later.

Time Shrapnel Ranging.

If the fuze be always set to the graduation of the fuze indicator opposite to the range, then if several rounds be fired with different range elevations, the shrapnel (if the fuze burns correctly) will all burst on the same plane. If the corrector be set to the normal, the height of burst should be that best adapted to give effect on the target. If the corrector be lengthened till the bursts are only about 15 feet above the ground, or rather above the line of sight, then the lower half of each cloud of smoke will

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obscure the target if short, or will appear behind the target if over.

This is shown in Figs. 71 and 72. Ranging with percussion shell would be difficult at this target, as

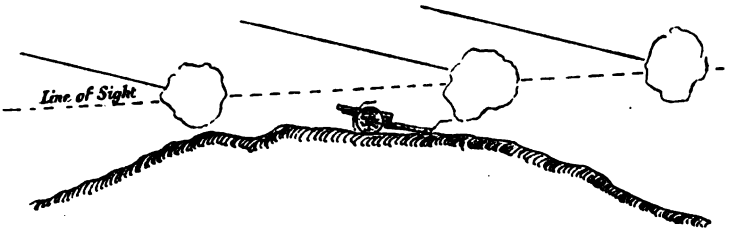

FIG. 71.

owing to the steep reverse slope behind the guns most rounds "over" would disappear. The second figure shows one gun and wagon of the target battery concealed by a burst short, and the next showing up against a burst over, while the other three guns are hardly distinguishable.

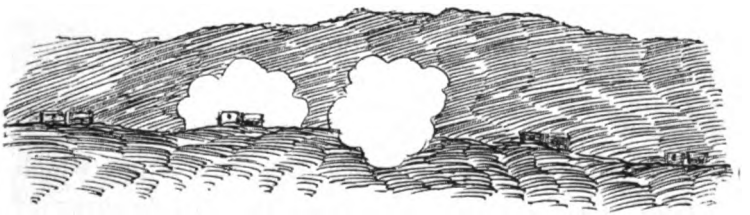

FIG. 72.

Ranging with time shrapnel is to be preferred whenever the ground is such as to render observation of percussion shrapnel difficult. It is carried out in the same manner as with percussion shell. When the 100 yards bracket has been obtained it is verified with percussion shrapnel.

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When the bullet strikes are visible, the process of time shrapnel ranging is much facilitated, and verification with percussion may be omitted.

When the sun is shining, it is often possible to see the shadow cast upon the ground by the cloud of smoke of a bursting shrapnel. This at once shows the position of the burst with respect to the target.

FINDING THE FUZE.

When the range has been found so that the mean trajectory passes through the target, the fuze has next to be found. The corrector scale of the fuze

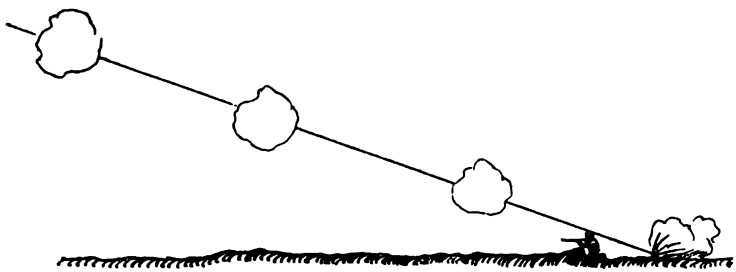

FIG. 73.

indicator, when set at the normal, 200, is intended to give a burst at the distance from the target which is most effective at each range. But the burning of fuzes varies according to the density of the air, the fuze burning fastest when the barometer is highest; and moreover the time taken by the shell to reach the target varies according to the strength of the powder, which is increased by heat. Therefore it is necessary to try several settings of the corrector scale, and to select the best.

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So far the battery commander has been ranging with one section only, say Nos. 3 and 4 guns. He has previously ordered the remaining guns to set their correctors at graduations increasing by 10, the order being "Echelon corrector 180, increase 10." No. 1 gun corrector is set at 180, No. 2 at 190, No. 5 at 200, and No. 6 at 210. Having found his bracket at, say, 3300 (−) and 3400 (+), and before firing his verifying rounds, the battery commander orders "Echelon 3350, 10 seconds." Then No. 1 gun loads with fuze set at the graduation which is opposite 3350 with corrector at 180, No. 2 the same with corrector at 190, and so on. When the two verifying rounds have been fired, these four rounds are fired at 10 second intervals. If, say, three burst in air and one on graze, as in the figure, the battery commander accepts the last in air, namely, that fired by No. 5 gun with corrector 200, as the correct fuze (subject to subsequent small corrections) and opens fire for effect at 3350 with corrector 200. So long as one round of the echelon bursts in air and one on graze, the battery commander can judge his fuze; if all four are on graze, or all four in air, he must fire a fresh echelon.

With time shrapnel ranging, the length of fuze (that is, the corrector setting) will have been determined in the process of ranging, and no subsequent echelon need be fired. But it may be necessary to fire a fuze echelon before commencing time shrapnel ranging, to get the proper height of burst.

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When once the corrector has been found, then on a change of target it is not necessary to fire a fresh echelon, so long as the atmospheric conditions are unchanged.

FIRE FOR EFFECT.

General.

The range and fuze having been found, fire for effect is opened at a rate corresponding to the tactical conditions. As a general rule, the fire is deliberate, alternating with bursts of rapid fire at critical moments, as when our infantry expose themselves in the advance or the assault, or when any movement of the enemy is perceived. But in every case, even when repelling a cavalry charge, the fire is kept strictly in hand, so that the target, elevation, and rate of fire can be changed in a moment at the battery commander's order.

Cases may occur, and must occur, in which the effect produced is uncertain, as when "searching" for a concealed target. Such situations involve the expenditure (not the waste) of a quantity of ammunition which is large in proportion to the probable effect. But this expenditure must be undertaken deliberately and systematically, and for good tactical reasons. If batteries be allowed to fire wildly at every likely-looking ridge on the chance of there being an enemy somewhere behind it, the quality and precision of their fire will permanently suffer, and they will become unable to hit a visible target.

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Methods of Fire.

The ordinary methods are: **Battery fire**, in which the guns are fired continuously in succession from flank to flank, at a named interval. **Rounds of battery fire** are frequently used; each gun, from No. 1 to No. 6, is fired once, and is not re-loaded till a fresh order is given. At **section fire** the guns of each section are fired continuously (unless a certain number of rounds is specified) at a named interval, independently of the other sections. At **gun fire** each gun is fired independently, usually for a specified number of rounds, either at a named interval or as rapidly as possible. Gun fire is not used in heavy batteries. **Salvoes**, in which all the guns are fired together by order of the battery commander, are used in rare cases, as to distinguish the rounds from those of another battery.

Searching.

This means firing at a number of elevations in succession so as to cover a certain depth of ground.

Thus if reconnoitring patrols report that the enemy's reserves have been seen moving towards the ground behind a ridge, and if they have not come out again, they must still be there, and it may be desirable to search the ground as in Fig. 74, which represents four rounds of battery fire, the range being increased by 100 yards at each round. Searching may be continued by repeating the four elevations, or by working backwards and forwards over the same

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ground. Or the three sections may fire simultaneously at different elevations, each **sweeping** to cover the full width of the target. Searching may also be employed when, although a long bracket can be

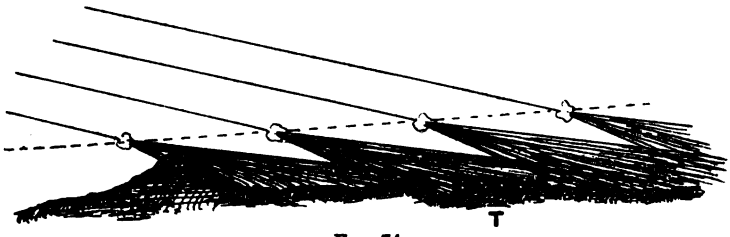

FIG. 74.

found, the conditions of observation render it impossible to divide it. When the ground is known to fall away behind a covering crest, the corrector should be lengthened for the longer elevations, so as to bring the bursts to the proper height.

Sweeping.

When a target wider than the battery is engaged, it may be divided into portions which are engaged successively, or else the fire may be spread over the whole target. The latter method, called **sweeping**, is illustrated in the diagram opposite.

The target is divided into three parts for the three sections, and each of these into two parts for the two guns of each section. Each gun then fires alternately at right traverse, centre, left traverse, and so on, so as to cover the target allotted to it. In practice sweeping is not usually carried out with minute accuracy as in the figure, but the flank sections are given an amount of outward deflection estimated

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sufficient to cover the target, and the sweep of the guns is ordered in round numbers, as one degree right and left.

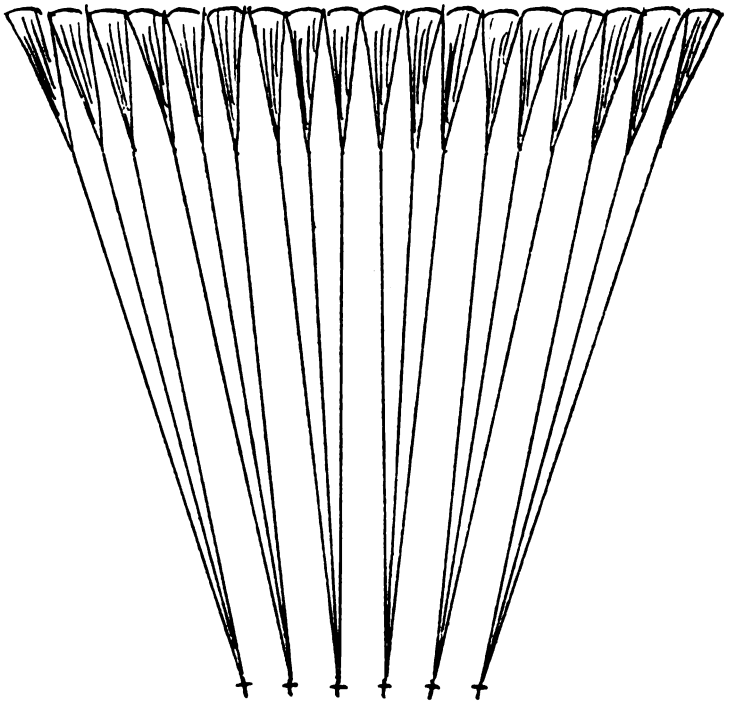

FIG. 75.

Sweeping is also used for the same purpose as searching, when the exact direction of a concealed target cannot be determined.

Concentration and Distribution.

The order is "Concentrate 10 minutes on No. 1," or "Distribute 10 minutes from No. 3." In the first case No. 2 gun gives 10 minutes right deflection,

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No. 3 20 minutes, and so on; in the second case Nos. 2 and 4 give 10 minutes outwards, Nos. 1 and 5 20 minutes, and No. 6 30 minutes. The number of minutes ordered is reckoned roughly by the displacement table given under *Laying*, or by the gunner's rule.

Fire is usually distributed from the first round, each gun taking the portion opposite it, but the fire may be concentrated on one point for ranging if desired. The order to distribute is used in the concealed position, where the layers cannot see the target.

Change of Target.

The procedure is as in ranging on the original target, except that, the corrector having been found, it is unnecessary to fire a fuze echelon. When the new target is at a shorter range than the old one, the time shrapnel in the guns (if any) will be effective as percussion shrapnel for ranging at the new target. This applies especially to howitzer shell, which cannot be unloaded to re-set the fuzes.

Change of Position.

This is dealt with in Part III. As a matter of fire-discipline, the procedure is as follows:

When an advance is imminent, the battery commander informs the captain, who has to see that six full wagons are with the fighting battery. Usually he brings up six fresh wagons from the wagon line, and, after the battery has advanced, leaves the Q.M.S.

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to collect the contents of the partly-emptied wagons so as to make (say) three full wagons, and to send the empty ones to the ammunition column to replenish. If the battery is not under fire, he brings up the limbers and teams, provided that this can be done without exposure. It may frequently be necessary, before limbering up, to run the guns back under cover, and also the wagons if time permits.

Before a retirement, the whole of the wagons, both of the fighting battery and the first line, are usually sent back under the captain, who selects the fresh position and awaits the battery. The ammunition required by the guns in the meantime is either taken from the wagons and laid on the ground (any surplus being carried off on the limber footboards) or else "limber supply" is ordered. The captain takes the rangetakers with him, and, if the position is to be a concealed one, the second director, and makes every possible preparation for opening fire.

When an advance is ordered, the battery commander rides forward, leaving the battery leader to limber up and follow him. When an advance is probable, but it is not known when it will take place, it is desirable, and sometimes possible, to send forward an officer with the rangetakers and director to reconnoitre and prepare for opening fire.

Section Control.

When a new target is to be engaged, but it is desired to keep up the fire on the old one, one section of the battery may be detailed for the latter purpose.

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Or if two targets appear simultaneously, a section may be detailed to engage one of them. The order is "(Right) Section, Section Control," and the section commander becomes for the moment independent, and directs the fire of his section himself.

MOVING TARGETS.

Small rapidly-moving targets such as patrols are rarely worth powder and shot. The usual moving target is infantry advancing in scattered formation; artillery and cavalry may sometimes be caught on the move.

The corrector must first have been found, otherwise there is little chance of producing effect.

At infantry advancing in scattered formation, or intermittently visible during their advance, a long bracket of 300 or 600 yards is found and searched from end to end. If the infantry are in a single line of no depth, the best way is to range on points in their line of advance, such as crests or hedges, and open gun fire when they reach these points.

When a battery is caught on the move, limbering up, or unlimbering, it is desirable to make the most of the opportunity. A long bracket should be found with two rounds of time shrapnel, and repeatedly searched with gun fire.

The same applies to a C.O.'s staff, if this can be recognized.

Except in the cavalry combat (see *Tactics*) the only time when cavalry in formed bodies is likely to

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be visible is when cavalry charge the guns. Even then they will not, if they can help it, deliver a frontal charge, but will make for the flanks and the wagon line. Section control will therefore be the normal method. The section commander orders the elevation, well short of the estimated range, and orders the fuze directly ("fuze 3," "fuze 2," and "fuze 1") instead of ordering the corrector. At ranges of 2000 yards and under, the elevation with which the shrapnel is fired is of little consequence.

A cavalry attack visible at 2000 yards is a rare occurrence, and is easily beaten off. The dangerous form of attack is when the cavalry can get within 500 yards unseen, and can form up under cover to charge. The only possible order is then "fuze zero, gun fire."

OBSERVATION OF FIRE.

General.

Observation is chiefly a matter of experience, good eyesight, and good glasses with a large field. However, a few points may be noted which will be of assistance.

The process of ranging with percussion shell consists of firing shell at certain elevations so that the position of the bursts with reference to the target can be observed. Now it by no means follows that the ranging shell should be fired at the target.

Suppose the target to be a company of infantry in a large irregular gorse-covert, where the burst of

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a shell is difficult to locate, with a slope of open pasture to the right of it. Then the proper course is to range on the open ground, where every burst

FIG. 76.

is visible, and, when a 100 yards bracket has been obtained, to shift the line on to the covert.

Similarly, when firing at a line of men in a ravine on a hillside, the battery commander should range

FIG. 77.

on the upper end of the ravine at R. For if the first shell falls into the deeper portion lower down, it may disappear altogether, and there will be nothing to show that it has not gone right over the hill.

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False Crests.

Suppose a target at T, with a ridge A of the same height in front of it. Then it may be difficult to determine whether T is on the ridge A or no, and whether the burst at A is on the same ridge as the target. The first point may be determined by looking at T from different points of view. For instance, if a point on ridge A can be located in line with T, then on shifting 100 yards to the right it will appear

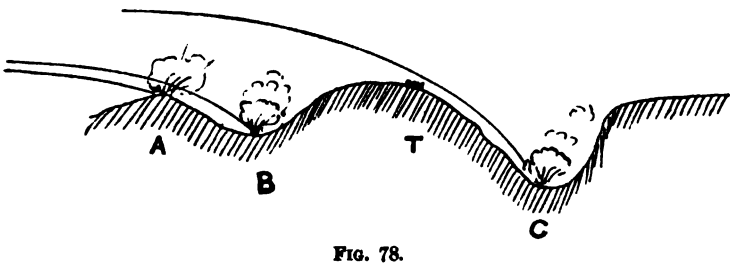

FIG. 78.

to the left of T. Similarly as regards the shell-burst, it is only when in line with T that it becomes puzzling, and an observer sent out, say, 200 yards to the opposite flank of the battery should have no difficulty in locating it.

In Fig. 78 the difficulty is increased by the hollows in front of and behind the target. A shell dropped into the deep hollow at C will either disappear altogether, or the smoke, when it does appear, will be at a point far to leeward, having been blown along by the wind in the meantime. A shell dropped into the hollow in front of the target at B will not appear immediately, but by the time the smoke rises

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to the level of T it will have thinned so that the target shows through it, giving it much the appearance of a burst over. This error can be avoided or detected by careful verification. For though a shell at the bottom of a hollow may be deceptive, there is not likely to be much doubt about one which strikes only a few feet down the side of the hollow.

Frequently a burst behind the target makes it show up. This is seen in Fig. 72.

With howitzers, the burst on graze of the heavy shrapnel is usually easy to observe. In difficult cases lyddite shell, which gives an enormous cloud of smoke, is used for ranging.

Whenever the enemy's men are visible, close observation of their movements with the telescope gives the most reliable indication as to the effect of the fire.

Methods of Observation.

In ordinary cases the battery commander himself observes the fire, using field-glasses for ranging and the telescope (which has a much smaller field) to observe fire for effect. In the open position, section commanders observe the fire of their sections, and order the deflection (not the elevation) so as to cover the portion of the target allotted to them.

If observation is at all difficult, the battery commander, if possible, sends out an **advanced** or **flank observing party** to assist in observing. In heavy batteries and heavy howitzer batteries these are always used. An observing party consists of an officer, if available (otherwise a senior N.C. officer),

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a signaller, and a horseholder. The telephone is only used in deliberate work, such as the attack or defence of an entrenched position.

Cross observation is illustrated in Fig. 79.

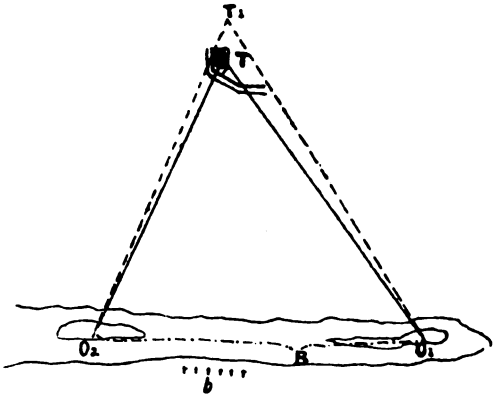

FIG. 79.—CROSS OBSERVATION.

B. Battery commander.
b. Fighting battery.
O1, O2. Observing stations.
T. Target.
T1. Fall of shell.
— • — • — • Telephone lines.

If two observing parties at O1 and O2 align their directors on the same point T of the target, and *if the line is correct*, then a shell falling over, as at T1, will appear to the right from O1 and to the left from O2; if short, it will appear to the left from O1 and to the right from O2.

When there is plenty of time, the distance O1–O2 is carefully measured, and these points are connected by a telephone line, besides the telephones connecting them with the battery commander. Then if any target appears in the foreground, the two directors are layed on the same point of it, and the angles TO1O2 and TO2O1 are sent to the battery commander, or

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rather to the observation officer with him. (In a field gun battery, which has no observation officer, a subaltern would be specially detailed for this duty.) By plotting these angles on a drawing board,[1] or setting them on the field plotter, the range is obtained. If, now, a shell bursts at T1, it is reported from O1 as "20 minutes Right," and from O2 as "5 minutes Left." These angles are plotted on an enlarged diagram, showing only the apex of the triangle, by means of a scale of natural tangents. Thus if the distance TO1 be 4500 yards, the natural tangent of 20 feet is 19 yards; if TO2 be 4300 yards, the natural tangent of 5 feet is 3·2 yards. The lines to T are already drawn on the diagram, and lines drawn at 19 yards and 3·2 yards, to scale, from these, give the situation of point T1, where the shell burst, as 22 yards over and 11 minutes Right.

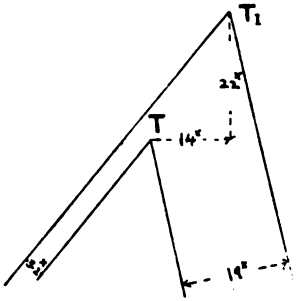

FIG. 80.

This is the siege method of observation, and would be used, for instance, in attacking a semi-permanent redoubt which has taken a week to construct. But a rough version of the method, in which the distances are not measured, and the bursts are reported merely as "Right" or "Left," should be used for observing deliberate fire whenever even a single flank observing station is available.

[1] Such as a kitchen table raided from the nearest house.

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Advanced Observers.

When supporting infantry, whether in advance or retirement, it is frequently desirable to have an artillery officer with the firing line, or some ¼ mile behind it, to see what is going on. This officer will probably not be able to observe the fire of his own brigade so well as the battery commanders, but he can observe and signal back the points on which fire is required to be directed, when the volume of fire is to be increased, and when fire should be stopped. This subject will be further considered under *Reconnaissance.*

Observation from Captive Balloons.

This is very useful when it can be carried out. But it is only in exceptional cases that the officer ranging a battery will have a balloon at his disposal. Practice in observation is essential; it would be a mistake to suppose that any untrained sapper non-com. can observe fire from a balloon. Similarly the artillery officer, when he first attempts to observe from a balloon, is puzzled by the unfamiliar aspect of the ground. It requires practice to use glasses from a balloon, owing to the motion of the car and the vibration produced by the rope. Angles can be measured with the knuckles or with the rule held at arm's length, but instrumental observation of angles is difficult.

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Observation from Man-Lifting Kites.

In some cases this may be of great value, as when a favourable wind allows the kite to be flown towards the enemy. There is little risk of the observer being

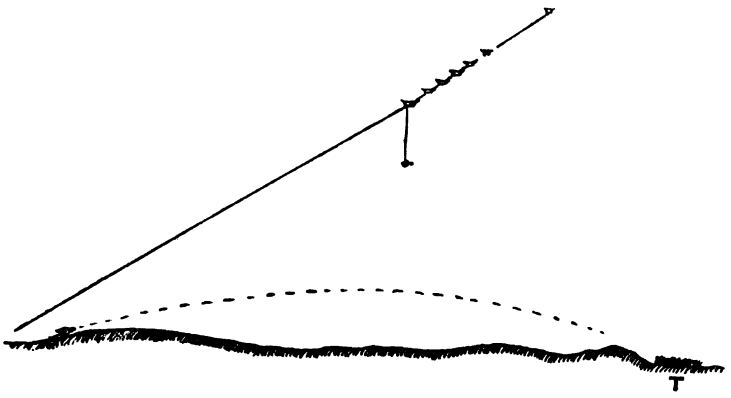

FIG. 81.

hit. Kites are only suited for deliberate work, as it takes some half-an-hour to get the pilot and string of kites up. Observation is subject to the same difficulties as in a balloon.

REPLENISHING AMMUNITION.

Ammunition supply, on the large scale, is dealt with in Part III. In the battery, the immediate supply for the guns is taken from the wagons alongside of them, and it is the business of the captain to keep these wagons replenished from the wagon line. When possible, he takes advantage of pauses in the enemy's fire to bring up fresh wagons, which drive up

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on the unoccupied side of each gun; the teams take the partly-emptied wagons to the wagon line, where the ammunition is re-packed so as to leave some wagons empty, and these are sent off to the ammunition column to be re-filled or replaced by column wagons. When the enemy's fire renders it inadvisable to bring up the teams, the fresh wagons are brought up as close as safety permits, and thence run up by hand. If this cannot be done, men from the wagon line must be employed to carry up ammunition. In the Manchurian war the infantry were called in to assist. In an entrenched position, extemporized sleighs and picket ropes may sometimes be used to haul up ammunition.

Cases may arise in which it can be foreseen that the expenditure of ammunition will be great, while it will be difficult to replenish it. If, for instance, a battery occupies a position in the open, with unsheltered approaches, under cover of darkness, mist, or heavy rain, it may be advisable to place a wagon on each side of every gun. This is advocated by some French officers as the normal method.

When a battery advances, it should always be accompanied by full wagons. (See *Change of Position.*)

REPLACEMENT OF CASUALTIES.

Personnel.

There is a regular order of replacement laid down in all armies, the captain replacing the major, the senior subaltern the captain, and so on. But when

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hotly engaged it is neither possible nor desirable to "change rounds" right through the battery, and the next senior on the spot takes the vacant place, the major being replaced by the sergeant-major and the captain by the Q.M. sergeant. At the guns, the captain details men to replace casualties. Thus if a gun detachment is wiped out by a well-placed howitzer shrapnel, the captain sends the best available N.C. officer to replace the No. 1, and fills up the detachment from other guns. Fresh men are brought up from the wagon line to take the vacant places. On emergency a single man can keep up a rate of fire of from 2 to 3 rounds per minute from a Q.F. gun.

Besides replacing the killed and wounded, the captain should relieve the men at the guns, when fatigued, by spare men from the wagon line. Section commanders should relieve their layers before, not after, their eyes get tired.

Materiel.

A Q.F. gun is a complicated piece of mechanism of which parts are liable to break down or to be injured by the enemy's fire. Spare parts of every description are therefore carried. The general idea is that all parts which can be replaced in the firing line are carried with the fighting battery, while those which require much time and labour to replace are with the ammunition column or the transport. Wheels are an exception. They used to be carried with the fighting battery, but a Q.F. battery empties so many ammunition wagons that a wheel can always be taken from a

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wagon body, which is left on the ground till the second line comes up. The spare parts most likely to be wanted, such as striker-points and springs, are carried in each wagon. More important parts, such as panorama telescopes, are carried at the rate of one per battery. It is the captain's business to know where the wagon containing each spare store is to be found, so that if, say, a spare sight telescope is required he can send for it at once.

If any repairs in front of the shield have to be done to a gun under fire, the wagon limber may be run in front of it for protection.

It is not desirable to send guns to the rear for repairs, as this will give rise to rumours of a retirement.

FIRE DISCIPLINE OF HORSE ARTILLERY.

In the cavalry combat, mobility is of great importance, and the fighting battery wagons are often left with the first line. When this is done, **limber supply** is used, the limbers being unhooked on the left of the guns.

In reconnaissance, horse artillery is mostly used by single sections.

Otherwise the fire discipline is the same as in a field battery.

FIRE DISCIPLINE OF FIELD HOWITZERS.

When a field howitzer is used as a gun, firing shrapnel with full charge below 15° elevation, the

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fire discipline is the same as in a field gun battery. When used as a howitzer, for high-angle fire, there are a few minor points of difference.

With a field gun battery, the line of fire should be approximately at right angles to its front; with howitzers, this is of no great consequence, and the battery can, on emergency, fire from column. A field gun battery should not fire from a position within 400 yards behind other troops, on account of the danger to them from possible prematures. With a howitzer battery firing shrapnel (not high-explosive shell) troops close in front of the muzzle would be safe from a premature, as the bullets would go up in the air.

When used as a gun, a field howitzer is layed with open sights and yard scale, but for high-angle fire the elevation is always given in degrees by clinometer, and the direction by the panorama sight.

A field howitzer can get much closer behind steep cover than a gun. It can fire from a ravine, or from a street between houses. On the other hand, since it requires 20 feet of cover above the muzzle to hide the flash, while a gun only requires 10 feet, it has to be further down the slope, that is, further from the crest and the observing position, than a gun. The result in either case is that the howitzer battery is not usually visible from the observing position, and that two directors (see *Laying*) are used to give the line.

A field howitzer has five or six charges (see

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Artillery Fire), and the charge, as well as the elevation, has to be ordered.

In finding the fuze, a howitzer battery fires only two fuzes at a time, not four, on account of the importance of economizing ammunition. (This does not apply to direct fire.)

FIRE DISCIPLINE OF MOUNTAIN ARTILLERY.

A mountain battery comes into action as described under *Manœuvre*. It has eight ammunition mules

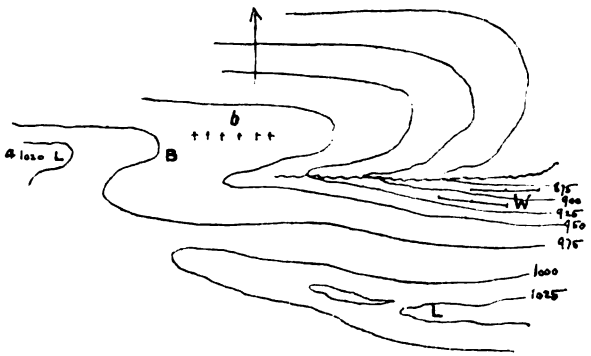

FIG. 82.—MOUNTAIN BATTERY IN ACTION.

B. Battery commander. W. Ammunition line.
b. Battery. LL. Look-out men.

per gun, two with the gun line and six with the ammunition line.[1] Each mule carries two ammunition boxes, each containing eight rounds. In action, four boxes are placed beside each gun. To replenish these, fresh mules are brought up. A

[1] The fighting line of a mountain battery is also called the *first line*, the first ammunition echelon the *second line*, and the remainder the *third line*. To avoid confusion, the terms gun line and ammunition line have been adhered to in this book.

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mountain battery is specially taught to avoid the sky-line, and guns are unlimbered[1] below the crest, and then run up; to limber up, they are run back under cover when possible. In other respects the fire discipline is the same as with field guns.

HEAVY FIELD GUNS AND HEAVY HOWITZERS.

The fire discipline is much the same as with field guns and field howitzers, except as regards observation of fire. A heavy battery cannot change position as quickly and easily as a field gun battery, and it is less necessary for it to do so, since it has an effective range of some five miles. But observation of fire at anything over 5000 yards is rarely possible. Therefore a heavy battery has two observing parties, which are pushed forward as close as possible to the enemy, and connected with the battery by telephone or signal. In following the phases of the combat, it is usually easier to shift the observing party than to shift the battery.

Moreover, a heavy battery is frequently placed in a central position with the object of bringing fire to bear on any part of the battlefield where it may be required. Thus when engaging a target to the front it may be called upon to turn a section on to a target distant some 6000 yards to a flank. A second observing party is therefore necessary.

With field guns and field howitzers, the battery

[1] The terms *unlimber* and *limber up* are used in mountain batteries, although these have no limbers.

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commander almost always ranges the battery himself, even if the observing position be 1000 yards away. With heavy guns and heavy howitzers, the battery commander would be too far from his battery if he accompanied the observing party; therefore a special

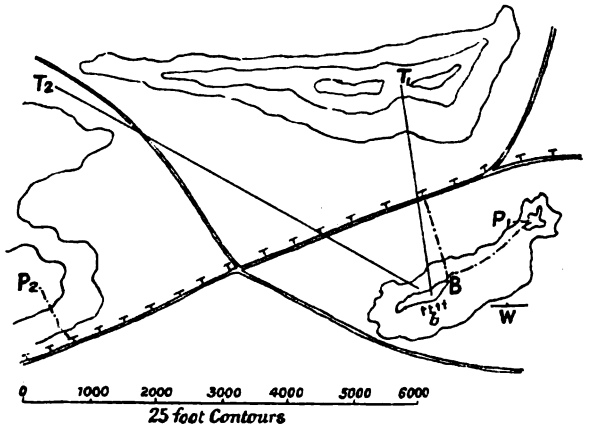

FIG. 83.—HEAVY BATTERY IN ACTION WITH OBSERVING PARTIES.

B. Battery commander and staff.
b. Battery.
W. Wagon line.
T 1. Original target.
T 2. Second target.
P 1. First observing party with observation officer.
P 2. Second observing party.
— · — · — · Telephone lines to observing parties.
Telegraph line on main road partly utilized for communication with P 2.

officer, called the **observation officer**, goes out with the observing party and ranges the battery. If a second party be used, either an officer or a specially-trained senior N.C. officer is sent with it.

In "deliberate" situations, whenever possible, **cross observation** (see *Observation of Fire*) is used.

The formation of a heavy field battery or heavy howitzer battery and observing parties is illustrated in Fig. 83. The formation of the fighting battery

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and wagon line is the same as in a field gun battery, except that there are only four guns instead of six.

RANGING AT BALLOONS, AEROPLANES, AND KITES.

General.

The trajectory of a field gun does not rise much above 1500 feet, even at extreme ranges, unless the trail can be buried so as to give more elevation. But if this be done, traversing becomes impossible. The field howitzer is capable of throwing a shell to a height of 3600 feet, but its curved trajectory makes it very difficult to hit a moving target. The 40 pr. high-velocity balloon gun is effective up to 30,000 feet, and the 12 pr. up to 20,000 feet. This high velocity is a great advantage, not because a balloon is

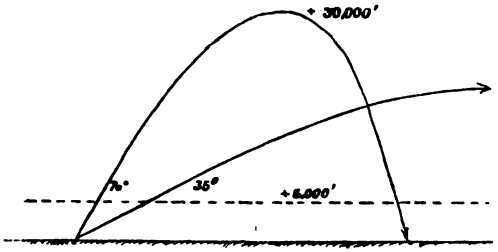

FIG. 84.

ever likely to be fired at at such a height (5000 feet is about the limit of ascent), but because the first part of the trajectory, as seen in the annexed figure, is nearly a straight line.

The balloon gun fires smoke-trail shell, leaving a visible track which enables the flight of the shell to

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be followed, and renders it possible to make direct hits. It is the only weapon likely to be of much use against a dirigible, though of course an attempt would be made to hit the dirigible with field guns or howitzers if it came within their range.

Ranging with the Balloon Gun.

A flank observer is employed, stationed at least 400 yards distant. If not already in position, he gallops out when the target appears. His duty is simply to signal "high" or "low," according as the smoke-trail passes above or below the dirigible. A bracket of, say, 5 degrees is obtained in two shots, and four rounds of rapid fire are fired at the intermediate degrees. Thus if 35° is signalled low and 40° high, the four rounds are fired at 36°, 37°, 38°, and 39°. Since no preparation of fuzes is required, these four rounds can be fired in 10 seconds. If no hit is obtained, then if the observer signals "high and low," the "bouquet" is repeated; if he simply signals "high" or "low," a fresh bouquet is fired at 35-30 or 40-45 as the case may be.

Simultaneously with ranging for elevation, ranging for line is carried on; thus if the first shell pass astern of an airship travelling from right to left, left deflection is put on till they pass ahead of her, and the amount of deflection is then reduced.

It is necessary that the balloon gun be accompanied by a good one-man rangefinder. Special rangefinders have been designed for this purpose, with a time attachment which gives the speed of the balloon

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and amount of deflection required, as well as the elevation.

Ranging with Field Guns or Howitzers.

It is useless to fire ordinary percussion shell, without smoke-trail, at a balloon, except at ranges under 1000 yards or so, as they disappear from view, and there is nothing to show whether they pass above the balloon or below it. Time shrapnel is the only possible projectile.

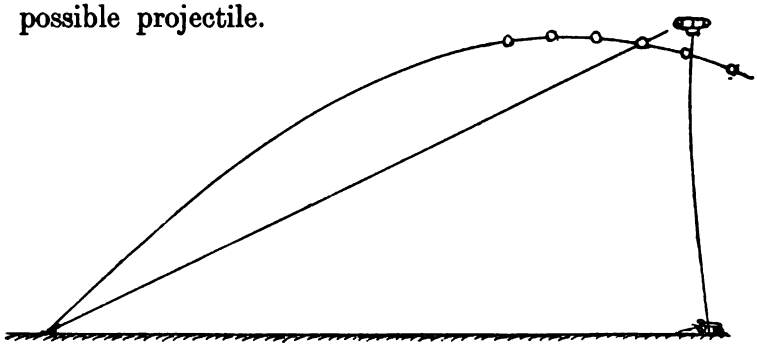

FIG. 85.

The first proceeding is to get a corrector which will give bursts on the line of sight to the balloon. The corrector will be longer than the normal, since the time of flight is longer for the same angle of elevation (not quadrant angle) when the angle of sight is increased.

For instance, one round of battery fire is fired with "corrector 200, increase 5" at the estimated range, as in Fig. 85.

Then corrector 220 is the one required. For the corrector scale is so graduated that a given setting will give bursts (approximately) on the same line of sight at any range.

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With this corrector, a bracket is found say at 3000-3600. (Fig. 86.)

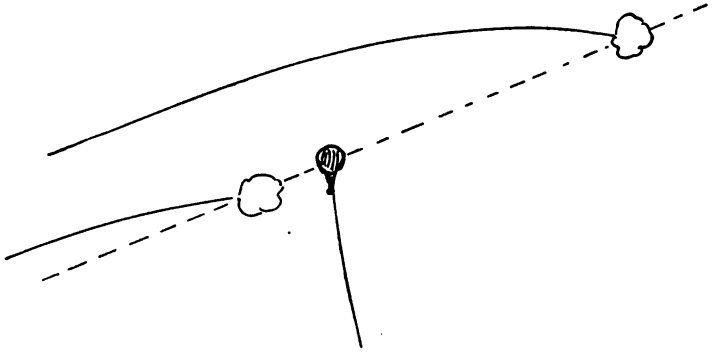

FIG. 86.

This bracket is then searched with one round of battery fire at 3 seconds interval, or a salvo, the elevations being 3000, 3100, 3200, 3300, 3400, and 3500. If the flank observer reports, say, 3 short, 3

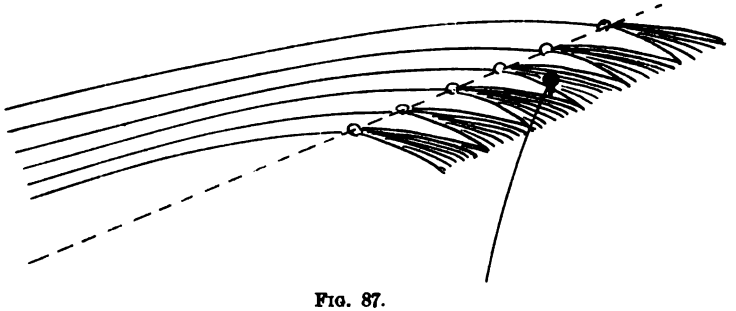

FIG. 87.

over, the next round of battery fire will be at 3000, 3050, 3100, 3150, 3200, including a bracket of 200 yards.

When the long bracket has been found it is advisable to shorten the corrector so as to give bursts about 15 minutes above the line of sight, to allow for

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the droop of the bullet-cone. But when this has been done it will be impossible to observe bursts short and over from the battery, and entire reliance must thenceforward be placed on the flank observers.

With a **man-lifting kite**, the procedure is much the same. It is not of much use to make hits on the kite with shrapnel bullets, as these are not likely to disable it. The method is to range on the kite, or string of kites, and shift the trajectory to hit the man suspended in the basket.

Neither a kite nor a captive balloon will remain in the same place when fired at; the detachment will haul in or let out the rope, or will shift with the ground end. Smartness in ranging is therefore essential.

If a **dirigible** comes within range of a field gun or howitzer, the same procedure may be attempted, and will at least have the effect of making the airship keep its distance.

Ranging at Aeroplanes.

With the balloon gun and smoke-trail shell, the method of ranging will be the same as that used against a dirigible; but the process will be rather like snipe-shooting with a rifle. With ordinary guns and howitzers shrapnel will be used. The best procedure would appear to be to find the corrector as at a balloon, make a 1000 yards bracket, and then fire a "bouquet" in the hope of the aeroplane flying into it.

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FIRE FROM AIRSHIPS.

In view of the small amount of gun ammunition that can be carried, it is not at present likely that airships will fire at each other at ranges much exceeding 1000 yards. With both ships in rapid motion, ranging or bracketing is out of the question. The gun will be fitted with speed sights as in the Navy, adjustable both for the speed of the ship firing and the target ship. Except when chasing or being chased, opportunities will be fleeting. In view of the danger to both, airships will be shy of approaching each other. Each will manœuvre to get above the other, where the opponent cannot fire at it. Smoke-trail shell will be used, as described under *Ammunition*. The projectiles used will be high-explosive shell with a fuze that will act on the envelope. The tactical methods employed are discussed in Chapter XXIX.

Dropping Explosives.

The gear used for this purpose is described under *Equipment*. There is reason to believe that shell can be dropped from a large and steadily moving airship with great accuracy. With good sights it should be possible, on a moderately still day, to drop 50 per cent. of shell into a circle 20 feet in diameter from a height of 3000 feet. Either high-explosive shell to burst on impact, or time shrapnel, can be used. The only limitation to which this nature of fire is subject is the weight of the ammunition to be carried. This subject is further considered in Chapter IX.

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There is no present prospect of the possibility of dropping or firing shells from aeroplanes.

FRENCH FIRE-DISCIPLINE.

The French battery consists of four guns, each with a wagon body tipped beside it, and with a machine by which fuzes can be quickly set. The battery commander opens with a salvo of time shrapnel at less than the estimated range, followed by a second with an elevation increased by 400 metres. Thus if the range be judged 3800 metres, the two salvoes are fired at 3600 and 4000, with corrector lengthened to give low bursts. If these salvoes give a bracket, a third salvo is fired at 3800. This being (say) plus, the range is between 3600 and 3800. Instead of at once proceeding to subdivide this bracket, the French first cover this area with a storm of fire ("*rafale*"). This consists of four pairs of rounds of time shrapnel from each gun, at successive elevations, in the present instance, of 3500, 3600, 3700, and 3800. These are fired in less than one minute. The effect of these 32 rounds of "*tir progressif*" is to cover the target area with a shower of 9600 shrapnel bullets, which will cause considerable loss if the target be anything but shielded guns or troops entrenched, and will probably prevent the enemy from advancing or from replying immediately. After the opening *rafale*, precise ranging is proceeded with as in our own service. If the target be wider than the battery, "*tir progressif et fauchant*" is used; in this each gun fires three

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rounds at each elevation, alternately at left traverse, right traverse, and centre, making 48 rounds in all. The subsequent fire for effect consists of slow fire alternating with *rafales* at favourable moments. In this last matter the French have been imitated by most other nations, including ourselves. But the indiscriminate use of *tir progressif* to search the long bracket is considered wasteful of ammunition.

The method of ranging by battery salvoes is hardly applicable to six-gun batteries, on account of the waste of ammunition. It has been proposed to use two three-gun salvoes, fired by the right and left half batteries, and there is much to be said in favour of this method, though it has the technical defect of temporarily upsetting the sectional organization.

GERMAN FIRE-DISCIPLINE.

The German methods are much the same as our own, except in two particulars. The German corrector is applied to the sight-socket, and has the effect of shifting the trajectory without altering the range on the sights. Thus if the shrapnel are bursting too low, as at A (Fig. 88), the corrector is raised, shifting the bursts to B, where they are ineffective; the range on the sight, and with it the fuze, is then shortened so as to bring the bursts to C, where they are again effective. This procedure is cumbrous compared to our own.

The second point of difference is in opening fire for effect. Whenever observation is difficult, the

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Germans commence with three elevations, as 3150, 3200, and 3250, each with the corresponding fuze.

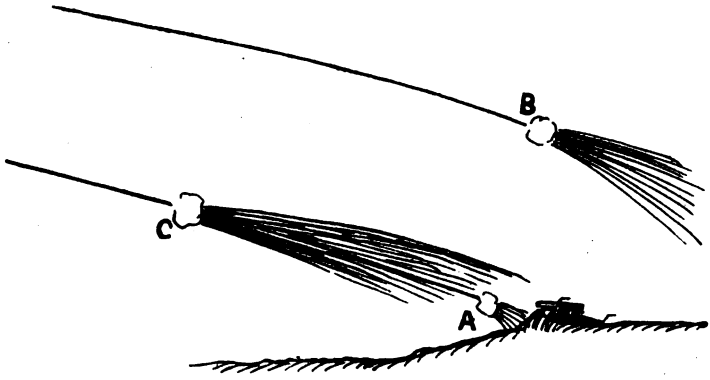

FIG. 88.

Fire is continued at these elevations alternately until the most effective of the three can be determined.

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CHAPTER XI.

ENTRENCHMENTS.

A GUN-EMPLACEMENT may be on the natural surface of the ground, or may be sunk below it. The former is usually preferable as giving a better platform and greater command. The amount of cover provided may vary, according to circumstances and time available, from a couple of trenches for each gun, in which the detachment can sit when not firing, to a storm-proof entrenchment with casemates and blindages.

FIG. 89.

In entrenching a gun, the first consideration is fire-effect, the second protection. The latter may be obtained by concealment and cover, concealment being usually the more important of the two. If it can possibly be avoided, a gun entrenchment should not be on the sky-line; the best position for concealment is a false crest on the forward slope.

But this is only suitable for a permanent gun-position, as the gun will necessarily be exposed

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when running it over the crest into the entrenchment, or in withdrawing it. In many cases the crest will be the only possible position, and the only resource is to make the entrenchment as inconspicuous as possible.

Thus in the figure there is no doubt as to which gun-epaulment is the more conspicuous of the two. Sometimes it is possible to erect a screen behind the entrenchment as at A; this will usually afford better concealment than a screen in front, since the latter must be low enough not to interfere with fire.

FIG. 90.

FIG. 91.

At Port Arthur the Japanese captured a good many Russian trenches. At first they used to adapt these by shovelling the parapet over to the new front, but on several occasions, when there was no time for this, they found that better protection was obtainable by keeping the parapet behind them than by firing over the top.

FIG. 92.

It is most important to fill up the intervals between gun-epaulments with a screen, even if only of brushwood. For six neat little mounds at regular intervals on the sky-line will catch the eye of the rawest recruit.

The selection of the situation of gun-pits to

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command the forward slope of a position is a most difficult matter. A concave front slope is a rarity, and in nine cases out of ten it will be found that guns on the crest have a lot of dead ground in front of them, just where it is most important that attacking troops should be kept under fire. When possible, this dead ground is swept by oblique fire, as at AA in the figure; where this method fails, gun-pits, with

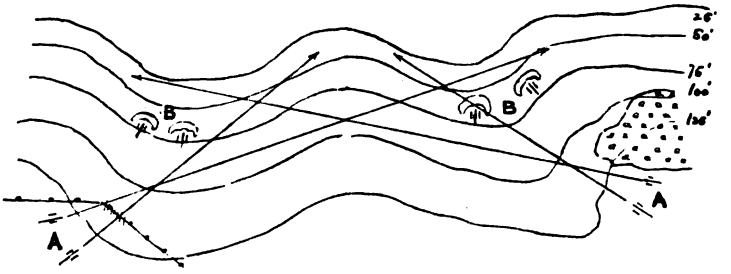

FIG. 93.

overhead cover if possible, must be constructed well down the slope at BB. The tactical employment of these forward gun-entrenchments will be considered in Chapter XXV.

The site of a gun-entrenchment having been selected, the first proceeding is to mark out the gun-platform, which must be large enough to enable the gun to be traversed so as to take on any prospective target. Where this is incompatible with good cover, the best way is to prepare two alternative emplacements for different targets. In S. Africa, the pattern shown in the figure was used when a large arc of fire was required. It consisted of a semi-circular parapet struck with a 10 foot radius to the crest, with a deep

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narrow trench inside it. With this pattern it was impossible to conceal the gun, and the gunners were exposed when working it.

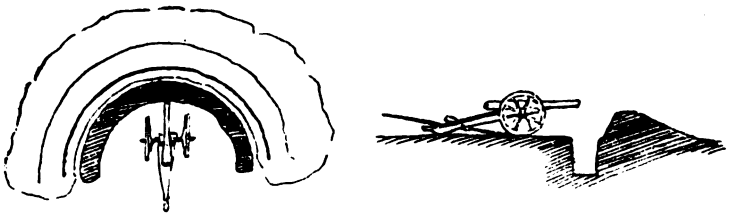

Fig. 94.

The ordinary gun-epaulment is commenced as in the figure, by digging a trench on either side, clear of

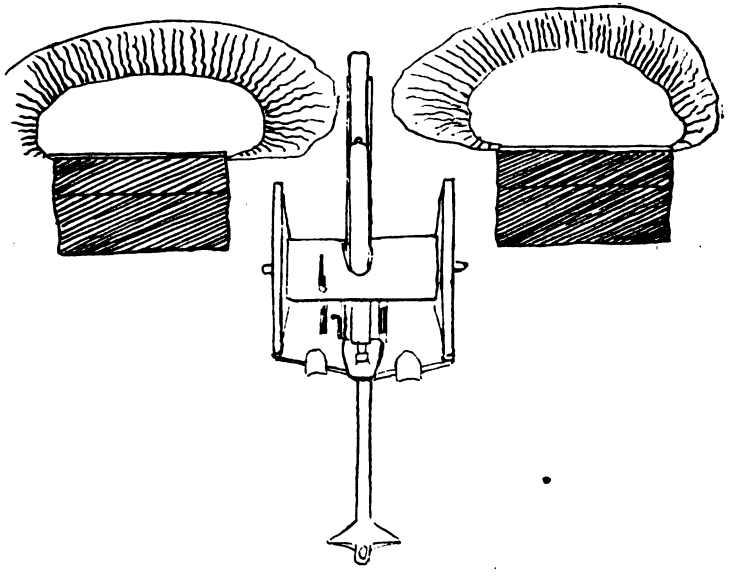

Fig. 95.

the gun-platform, and deep enough for the men to sit in, so that they are protected from rifle fire and gun shrapnel fire. With eight gunners digging and three

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drivers cutting sods, this takes one hour in easy soil. The next hour is spent in raising the two parapets to the height of the top of the shield and connecting them by a low parapet in front of the wheels, sloped up into the main parapets at the angles. The front of

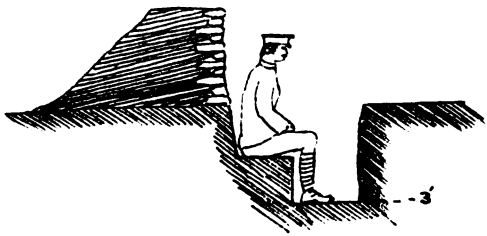

FIG. 96.

the parapet is covered with sods to conceal the fresh-turned earth. The ends of the parapet are sloped down gradually and the outline is continued with a thin sod wall so as to make the whole entrenchment as little conspicuous as possible.

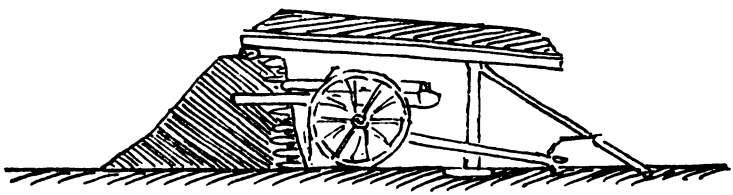

FIG. 97.

The next step is to provide overhead cover. This requires timber and planks, sheet-iron, or other material capable of holding up the earth. To protect the men serving the gun, a log is laid across the two parapets, above the wheels, and a couple of doors from a house, or similar flat pieces of material, are

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rested on it and supported by uprights; the whole is covered with one foot of earth, which is sufficient to keep out shrapnel bullets. The time required for this part of the work alone is two hours, provided that material is obtainable within a quarter of a mile. A field gate covered with brushwood and one foot of earth makes good overhead cover, and the gate posts can be used to support it.

Lean-to shelters for the men in the two trenches are made in the same way, but are easier to construct than shelters for the men serving the gun, since the roof is much lower.

If the entrenchment has to be made proof against percussion high-explosive shell from field howitzers, this will be a formidable undertaking. Instead of a door and a foot of earth, it will be necessary to provide a roof of rails, logs or balks with five feet of earth at least on top of it; even this will hardly keep out howitzer shell with delay action fuze. A roof 10 ft. by 8 ft. covered with 5 ft. of earth weighs at least 6 cwt. per square foot, or 24 tons, and this will take massive uprights to support it. At a rough estimate, supposing materials handy and a company of infantry available to help, it should take a field battery four days to construct shell-proof casemated cover for itself. Even then the arc of fire will be limited to some 25 degrees, and if an arc of fire of 90 degrees be required the casemates will take at least a week to construct.

It is practically impossible to provide shell-proof cover for a howitzer, as it would have to be run out

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almost clear of the shelter to fire at full elevation. Howitzers must rely upon concealment, with blinded cover for the men not serving the gun.

Fig. 98 shows a casemated emplacement for a 60 pr. heavy field gun. This would take a squad of 25 men a week to construct, the materials being on the spot. The materials are 12 inch logs for the uprights and roof-beams, covered with two layers of rails. The

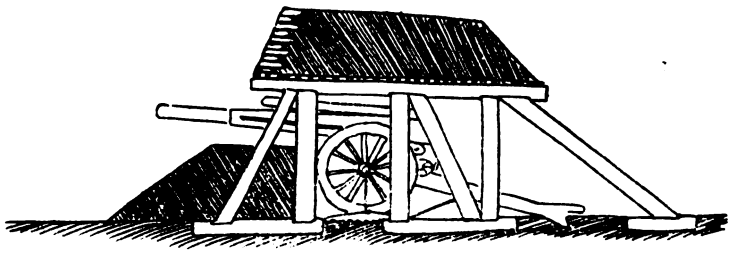

Fig. 98.

tools required in addition to those with the battery would be two cross-cut saws, two augers, and four mortise chisels; 25 lb. gun-cotton,[1] two wheelbarrows, two gang planks, and 500 sandbags would also be required. An arc of fire of 40 to 45 degrees would be obtainable.

Fig. 99 shows the gun intervals filled in with an infantry parapet of the Twydall pattern, with overhead cover for riflemen, guarded by a ditch and

[1] *Note.*—Rails are quickly and easily cut in the field with a small charge of gun-cotton, detonator, and primer. One-third of a slab is usually employed, and this cuts the rail clean across. It would take an unskilled man a couple of hours to saw through a heavy rail with a hacksaw. Rails can also be cut by nicking all round with a cold chisel and breaking them off, but this is hard work.

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unclimbable iron fence. For the five intervals, this is a week's work for 100 men with 25 wheelbarrows. Failing the iron fence, the ditch may be filled with a wire entanglement.

Fig. 99.

Shelters for the section commanders, battery commanders, and brigade commanders and their staffs are also required when artillery is entrenched. These are commenced as plain trenches of the form shown in Fig. 100, and are blinded if time permits.

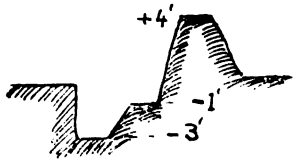

Fig. 100.

It is rarely desirable to entrench ammunition wagons beside the guns, as this involves heavy labour. It is better to provide ammunition recesses in which the rounds are piled horizontally, care being taken to keep them off damp ground.

In wet weather every trench must be provided with a pit in which the water collects, from which it can be baled out.

The situation of entrenchments is liable to be given away by the dust raised on firing. To obviate this, the ground must be thoroughly watered, not sprinkled, for a space of about 10 yards to the front and 5 yards wide. Fresh-cut branches laid on the ground

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will keep the dust down, but the leaves quickly fade and then become conspicuous to the enemy.

All forward slopes must be carefully turfed or sodded to match the natural colour of the ground.

Guns in position are sometimes betrayed by the bright tires of the wheels; this may be prevented by covering the wheels with blankets.

Until the guns open fire they should be kept run back, and the embrasures or spaces between the parapets filled up with sod walls or blankets.

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CHAPTER XII.

MISCELLANEOUS.

Destroying Captured Guns.

To disable the gun, when the time available is short, take the pickaxe and felling axe which will always be found on the gun or wagon; open the breech and attack the breech-block with the pickaxe; smash the sights; depress the gun to its full extent, and then bend the elevating screw by striking it with the felling axe. Fire a rifle from the side of the wheel into the cradle, and, if the bullet penetrates, fire several more shots into the hole, to destroy the buffer.

If there is no objection to firing the gun, it can be completely destroyed by double-loading it. For this, load the gun in the ordinary way, and insert a second shell point foremost into the muzzle; then run the muzzle up against the wagon, and fire with a rope from behind another carriage. If gun-cotton in small quantities is available, insert a gun-cotton primer and detonator into the cartridge, and fire the gun; this will detonate the smokeless powder and probably blow out the breech-block. If gun-cotton in larger quantities is available, a small slab exploded

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on the chase, where the metal is thin, will choke the bore. At the siege of Ladysmith, a sortie from the garrison disabled one of the Boer 6 in. guns in this manner. The Boers sent the gun back to Pretoria, where it was repaired by cutting a foot off the muzzle, and returned to Ladysmith.

If the enemy has removed the means of firing the gun, it is not easy to destroy it without gun-cotton. The best method is then to disconnect the horn on the gun from the recoil gear, by removing the nut with a spanner; elevate the gun, which will then slide off the cradle and leave the recoil gear exposed. The buffer can then be pierced with the point of the pickaxe, or bent with the felling axe.

If plenty of time is available, then, although the enemy may have removed the breech-block, the gun may be destroyed by double-loading with high-explosive shell. The chamber is filled with powder removed from two cartridges, and the breech blocked with a sandbag, leaving a channel for an extemporized fuse (a paper tube full of powder) by which the charge can be fired.

Cartridges are destroyed by taking out the powder and burning it; it will only blaze without exploding if burnt unconfined.

Shell are destroyed by laying them in a circle like the spokes of a wheel, with the fuzes inwards; a slab of gun-cotton detonated in the centre will blow in the fuzes and explode the shell.

Wagons and limbers may be destroyed by firing the guns into them, or breaking the axles with

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gun-cotton, otherwise it is not easy to destroy them on the spot. They may be temporarily disabled by removing the linch pins, but substitutes for these, such as bent cleaning rods, can be easily found.

If guns of our own have to be abandoned, the best way is to remove the breech-blocks (including the spare ones), as the enemy will probably be unable to replace them till the end of the campaign.

Casualties to Horses and Harness.

Our own harness is so completely interchangeable that it is a simple matter to replace a casualty; however, there are a few points which may be noted.

If the riding leader is shot, the driver mounts the off leader.

If a riding horse is shot, the rider sits between the two gunners on the limber, or mounts an off horse of the team.

If a driver is shot, the team goes on with two drivers, leaving the centre driver's place vacant, the reins being knotted. The alternative is to put up a gunner.

Any riding horse can be put into the team by putting the breast harness and traces on over his saddle; the traces may be passed through the stirrups.

If several horses of a gun team are shot, or the limber disabled, the wagon limber takes the gun forward, leaving the wagon body behind. Or the

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trail eye may be lashed to the rear of the wagon body.

All field wheels in our own service are interchangeable, except those of the 60 pr., and any wheel may be replaced by one taken from a transport wagon, even though this may not be exactly of the same diameter.

Crossing Obstacles.

The easiest way to cross a ditch or small stream is to cut down the banks. If the bottom is boggy it can be improved by putting down large sods. Unless beams are available on the spot, this is much quicker than making a limber bridge. Ammunition should be taken out if liable to get wet; this would not hurt the cordite, but would spoil the primers.

Deep and wide rivers can be crossed by hauling the guns across, provided that the bottom is sound, but this is not usually the case.

A gun can be rafted across by slinging it between two barrel rafts, each of six hogsheads end to end, lashed between two spars. Putting the gun *on* the raft is dangerous, unless a raft 20 feet square is used.

The body of a G.S. Wagon (Mark IX. and later marks) can be used as a pontoon, if the seams are caulked, or if the painted canvas cover is fixed under it and round the sides. The freeboard is low, and the resulting craft is only safe in smooth water. Two of these bodies, with 18 foot spars lashed across, will float a gun between them on emergency.

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Swimming Horses.

Artillery horses are easily managed in the water owing to their habit of keeping together. The best method is as follows: each horse's head rope is taken off and securely knotted to his tail. The horses are kept in their places in the team; a picket rope is attached to the head-collars of the leading pair and the end taken to the other side of the river, to keep them straight. As each pair enters the water, the ends of the head ropes fixed to their tails are knotted to the rings of the head-collars of the next pair, leaving about one yard between the tail of one horse and the nose of the next. It is essential to choose a place where the bank shelves gradually, as the horses will check if they have to plunge suddenly into deep water.

The harness has to be rafted across or taken in boats. Towing a horse behind a boat is not recommended; he sometimes tries to get in.

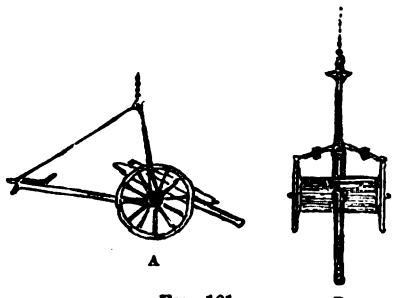

FIG. 101.

Slinging Guns.

A shielded Q. F. gun has to be slung by the drag-washers, the sling passing outside the wheels, as in Fig. 101, A. It is quite safe to sling the gun by the trail eye as at B; this may be necessary in order to get it down a hatchway.

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Transport by Rail.

Instructions are given in F.A. Training. When a brigade of 54 carriages has to be entrained, it is quicker to build an end-loading ramp than to try side-loading. Carriages are crowded together on the trucks as closely as possible and firmly lashed; nothing must project beyond the buffers. Horses are packed together closely in cattle-trucks. For journeys of more than six hours it is best to take off the harness. Restive horses are left to the last, and hauled in by a head rope and ropes attached to the breeching, passed through the truck to the opposite side of the rails.

When guns and horses have to be disentrained on the open line, if no materials for making ramps are available on the spot, the quickest way is to send the engine with a truck for a load of sleepers and rails. When a ramp for disentraining the horses has been built, the train is shifted so as to bring each truck opposite to it in turn. If there is a prospect of disentraining on the open line, materials for making ramps should be carried.

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PART III.

MINOR TACTICS.

CHAPTER XIII.

ORGANIZATION.

General.

The proportion of artillery to infantry, in the great Continental armies, has been fixed at 5·3 guns per 1000 rifles, and the same proportion now obtains in our own regular army. This includes field guns and howitzers of every sort except balloon guns. When the French introduced the quick-firing gun in 1898 they considered that its increased efficiency warranted a reduction of the proportion to four guns per 1000 rifles, but they did not foresee that the same increase of efficiency would also increase the relative importance of the artillery arm, and create a greater demand for artillery. Accordingly the French have now had to increase their artillery to the same proportion as in Germany and other countries.

The number of guns in an army is limited by the length of the ammunition columns.[1] Comparing the gun with the rifle, it may be calculated (at a

[1] See *Marches.*

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very rough estimate) that the amount of artillery ammunition required to kill a given number of men takes up ten times the road space occupied by an equivalent amount of small-arm ammunition. In view of the introduction, now steadily proceeding, of mechanical transport for ammunition, and its possible introduction for guns, it is quite possible that the future proportion of guns may show a further increase.

Army Organization.

An army is divided into **army corps**, each consisting of two or three **divisions**. The modern tendency is to organize the whole of the artillery on a divisional basis. The old **corps artillery**, which consisted of guns held at the immediate disposal of the army corps commander, has practically disappeared. The most important exception is in Germany, where the heavy howitzers (corresponding to our heavy field guns) are corps troops. But even these are usually attached to a division both for administrative and for tactical purposes.[1]

In our own army a **division** consists of three infantry brigades, each of four battalions, three brigades of field guns and one of field howitzers, and one battery of four heavy field guns. The divisional cavalry squadron will in future be replaced by Yeomanry or Mounted Infantry. The detail of the technical troops is given under *Marches*. This gives a proportion in the division of slightly over six guns

[1] The French artillery are organized on an army corps basis, but are not corps artillery in the above sense of the term.

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per 1000 rifles, but the average of 5·3 per 1000 includes the mounted brigades, which have a less number of guns, as will be seen.

A **cavalry division** consists of 12 regiments and four H.A. batteries, or four guns per 1000 sabres.

A **mounted brigade** consists of one cavalry regiment, two battalions mounted infantry, and one H.A. battery, or four guns per 1000 mounted men.

A **territorial division** has the same organization as a regular division, but each battery consists of only four guns instead of six.

Army Troops.

In our own army we have eight horse artillery batteries on the home establishment, besides those required for the cavalry division and two mounted brigades, and besides the Territorial H.A. batteries. These may be kept as army troops, but would probably be allotted to divisions on mobilization.

The following troops are not embodied in divisions, but are brought up from the base as may be required:

Balloon Guns.
Wireless Telegraphy Units.
Army Telegraph Companies.
Searchlight Sections.
Bridging Trains.
Siege Trains.

It seems probable that in most armies each division will in future have two balloon guns and one wireless station.

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Divisional Communication Companies.

These are important to the artillery, as, among their other duties, they link up the artillery brigades with the C.R.A. The organization of a communication company is not at present laid down, but the following would appear to be suitable:

One small wireless station, range 50 miles, for communicating with Field Army Headquarters.

Three sections field telegraph, each section capable of laying ten miles of field cable.

Three sections field telephone, pack equipment, each with three miles of light cable. (This in addition to one section with each infantry brigade, and one cable wagon with each artillery brigade.)

One lamp station of six lamps in wagon.

Twenty-four signallers on bicycles, six carrying heliographs, and all carrying flags and rifles.

Six motor cyclist orderlies (all signallers).

The whole commanded by one captain, provided with a motor car, and assisted by two subalterns on motor bicycles, and one warrant officer on a bicycle.

The company to be divided into a first and second echelon, the first to march with the G.O.C. division, the second in rear of the ammunition columns.

The C.R.A. of the division, when he takes command of the divisional artillery independently, to have a certain proportion of the communication troops, taken from the second echelon, allotted to him according to his requirements.

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Four motor cars, for the conveyance of the G.O.C. and staff, are attached to the communication company.

Artillery Organization.

In our own service the artillery unit is the **brigade** of three field batteries[1] each of six guns. A horse artillery brigade consists of two batteries only, and a heavy battery of only four guns. Each brigade has a **brigade ammunition** column, and each infantry division has a **divisional ammunition column.**

A battery, whether of horse or field guns or field howitzers, consists of six guns and twelve ammunition wagons. It carries ammunition on the following scale:

13 pr. gun, - - -	176	rounds per gun.
18 pr. „ - - -	176	„ „ „
Q.F. howitzer, - -	112[2]	„ „ „
60 pr., - - - -	76	„ „ „

It is commanded by a major, and is divided into three sections, each of two guns and four wagons, commanded by a subaltern. The captain commands the ammunition line. The interior organization of a battery is considered under *Manœuvre.*

Strength of Batteries.

The question whether a battery should consist of four guns or six still forms the subject of much

[1] Pending the issue of the Q.F. field howitzer, since completed, the strength of a howitzer brigade was temporarily reduced to two batteries.

[2] Approximate estimate. Official figures not yet published.

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controversy. It is practically a financial question. Without going into the whole argument, it may be accepted as conclusively proved that a four-gun battery is more efficient, gun for gun, than a six-gun battery. Also it is easier to lead and easier to conceal. But, on the other hand, each battery requires a complete staff, consisting of battery commander, wagon-line commander, sergeant-major, and trained specialists. If we organize our guns in batteries of four instead of six, we shall require 50 per cent. more staffs. From the financial point of view, which is not the ideal one, the strength of the army must depend, not upon national requirements, but on the amount the people are willing to pay for it. And, given a certain sum of money to spend, it is an open question whether better value can be obtained by spending it on four-gun or on six-gun batteries. In most countries the factor which has turned the scale has been the difficulty of reorganizing the corps of officers, since the change from six guns to four must upset the existing scheme of promotion. Accordingly we find that France is the only one of the great Continental powers which has adopted four-gun batteries, while Germany, Austria, and Italy adhere to the old six-gun batteries. The smaller States, such as Switzerland, Portugal, and Servia, have mostly adopted the four-gun organization. Russia is an exception, as the Russian battery consists of eight guns which can be fought as two four-gun batteries.

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Ammunition Wagons.

There is a further difference of opinion as to the number of ammunition wagons which should accompany a Q.F. battery. We have two per gun, the French three, and the Germans only one. The Germans consider that the length of a battery column of 18 carriages is inadmissible, as the infantry, the majority of whom march behind the artillery, would be too much delayed in deploying, and would arrive on the battlefield too late. Thus in the division the length of the column of 13 batteries (including those with the advance guard) is 5250 yards, or nearly three miles; if we deduct six wagons per battery from this we shall reduce the length to less than two miles. Therefore the Germans allow only six wagons in the battery, and seven per battery in the "light ammunition column," which corresponds to our first-line wagons, and marches immediately in rear of the infantry. If there are two infantry brigades between the guns and the light ammunition columns, these columns will be only half an hour behind; the batteries can hardly use up their six wagon-loads of ammunition in half an hour, and the light ammunition columns will be in plenty of time, and will be much less in the way when taking up positions than if they had accompanied the guns. With our own small forces, the system of marching the first-line wagons with the guns may be tolerated for administrative reasons. But in war on the large scale there is no doubt that the German method is sound.

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Ammunition Columns.

In our own service each artillery brigade is followed by its **brigade ammunition column**, consisting of 18 ammunition wagons and 21 general service wagons loaded with gun ammunition. The column also carries rifle ammunition for the infantry, namely, seven small-arm ammunition carts and nine G.S. wagons loaded with small-arm ammunition. There are also four store wagons. The column carries 3636 rounds, or 202 per gun, of 18 pr. ammunition, or a proportionate amount of howitzer ammunition. It is commanded by a captain, and has three subaltern officers. The duty of the column is to supply officers, men, horses, ammunition, and stores to its own brigade, and to other brigades if called upon. It marches immediately in rear of the fighting troops; in action, its position is a mile in rear of its brigade. If possible its position should be notified beforehand in operation orders, in order that both artillery and infantry may know where to send for ammunition; if this is not possible, the column commander must keep his brigade commander and the commander of the nearest infantry brigade informed as to his position.

A heavy battery has a small ammunition column of its own, carrying 98 rounds per gun.

The **divisional ammunition column** is a larger unit, consisting of 133 G.S. wagons. It carries 120 rounds for each field gun in the division, and a proportionate amount of howitzer ammunition. It is

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commanded by a colonel, assisted by an adjutant, and is divided into four sections, each with a major or captain and three subalterns. It is under the orders of the C.R.A., and marches one day in rear of the fighting force.

In the **cavalry division**, each horse artillery brigade of two batteries has its own ammunition column, carrying 220 rounds per gun, besides rifle ammunition for the cavalry. In the **mounted brigades** the single H.A. battery is supplied with ammunition by the **mounted brigade ammunition column**, which carries 220 rounds per gun, besides rifle ammunition. These columns replenish from the infantry divisional ammunition columns, which carry 144 rounds of H.A. ammunition per gun, besides the F.A. and rifle ammunition.

The organization of the artillery ammunition supply of a division is shown in Fig. 102. The fighting batteries replenish from the first-line wagons, these from the brigade ammunition columns, and these from the divisional ammunition column. This column sends its empty wagons to the advanced depôt to replenish; the advanced depôt is kept filled up by transport from rail-head, and the rail-head depôt from the arsenals at home.

In any civilized country the advanced depôt will presumably be on the railway. In England, for instance, it would be difficult to select a battlefield more than a day's march from a railway station.

The scheme of supply, as illustrated, is subject to considerable modification; thus in the figure the

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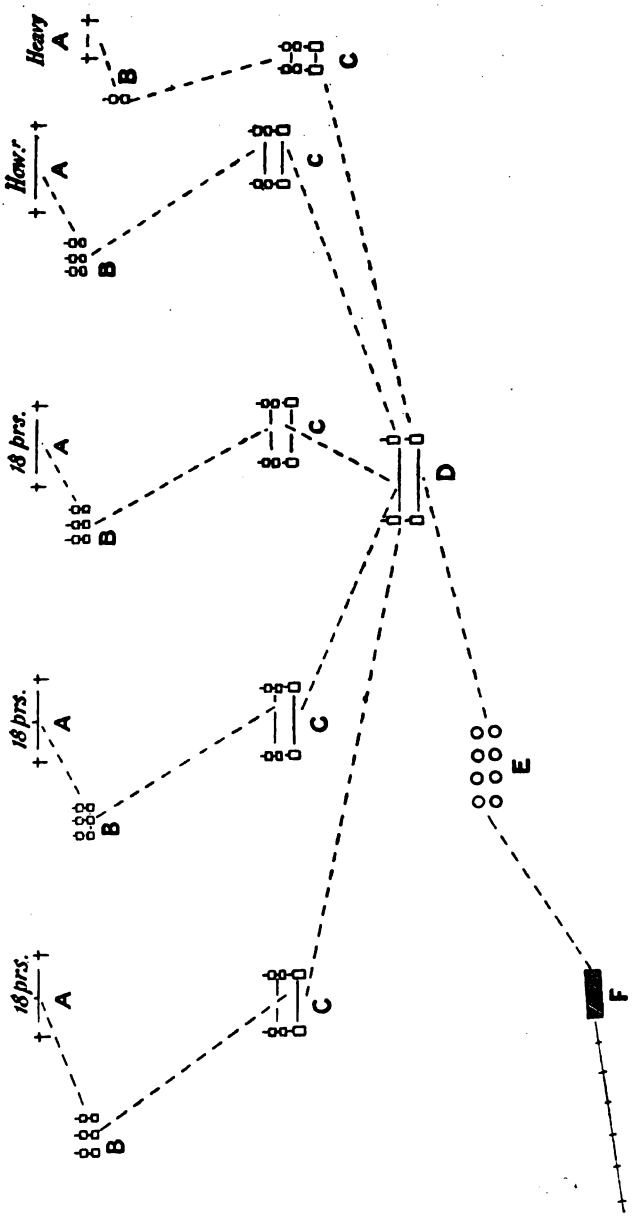

FIG. 102.—AMMUNITION SUPPLY OF THE ARTILLERY OF A DIVISION.

A. Brigades and heavy battery.
B. First-line wagons.
C. Brigade and heavy battery ammunition columns.
D. Divisional ammunition column.
E. Advanced depôt.
F. Rail-head.

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left-hand brigade ammunition column would probably replenish direct from rail-head.

The number of rounds at the advanced depôt (including those on their way up from rail-head) is so regulated as to give an approximate total in the field of

1000 rounds per field gun or H.A. gun.
750 „ „ field howitzer.
500 „ „ heavy field gun.

Foreign Armies.

The general system of ammunition supply is much the same as in our own army. The larger armies have army corps ammunition columns in addition to divisional columns, and the German army has the light ammunition columns already referred to as an additional link in the chain of supply, replacing our first-line wagons. The French estimate for 1500 rounds per gun in the field instead of 1000 as with us. But this figure is of little practical importance. In a country with numerous ordnance factories, and with a railway every 20 miles, there is no difficulty in getting an abundant supply of ammunition to rail-head. With mechanical transport, there is little difficulty in keeping the brigade columns supplied. The real difficulty is in getting the ammunition to the fighting line. Mechanical science will not help us here. In the open position it will rarely be possible to bring up horsed wagons, and the gunners, possibly assisted by the infantry, will have to carry up ammunition themselves.

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CHAPTER XIV.

COMMAND.

Artillery Command.[1]

Even when two or three divisions are formed into an army corps, it is unlikely, at least in our own army, that any officer will have to undertake the strategical or tactical command of more than the artillery of one division. We may therefore confine ourselves to artillery command within the division.

The G.O.C. division commands the artillery of the division just as much as he commands the infantry. Any system under which the G.O.C. merely commands the infantry, and tells the C.R.A. to act in support, is unsound. This is because the action of the infantry depends to a great extent upon that of the artillery; thus the situation of the artillery positions is a dominant factor in determining the G.O.C.'s plans.[2] To secure combined action, unity of command is

[1] No definite instructions on this matter have as yet come into force in our own army. The following paragraphs must be taken as representing the writer's personal views.

[2] Paragraph 368 of the German artillery regulations lays down that, "The artillery constitutes the structural framework of the combat. The distribution of the remainder of the troops depends, as a rule, on the positions assigned to the artillery."

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essential. Therefore the G.O.C.'s operation orders, before and during the battle, include the orders for both arms. This ensures that each arm is acquainted with the general dispositions of the other, so that both can act in concert.

Operation orders cannot possibly cover the minute details of the combat, down to the action of individual batteries and battalions; therefore to secure complete co-operation it is necessary that the commanders of infantry and artillery brigades which have to work together should be in direct communication. This part of the subject will be dealt with in Chapter XXIII.

There are two systems of issuing orders to the artillery. One is to issue divisional orders to the commanders of artillery brigades; the other is to issue them only to the C.R.A., who then issues his own orders, embodying in them such parts of the divisional orders as it is necessary for the artillery to be acquainted with. The former system is preferable, for two reasons. One is that, to secure unity of action, there should be only one set of orders in the division, and the G.O.C. is the man to give them. The second is that the orders for the artillery, framed with the C.R.A.'s advice, have already been included in divisional operation orders, so that his own orders will only be an extract from those of the G.O.C., and it will not be worth while to arrange for a special service of orderlies to deliver them.

It may sometimes be convenient for the C.R.A. to issue special orders embodying matters which do not

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concern the other troops: thus he may require brigade commanders to meet him at a certain place, or patrols to be furnished by certain units, or he may wish to notify that corrector 197 is found suitable to local conditions. But these must be considered strictly as special orders, and subordinate units must not be accustomed to wait for orders from the C.R.A. before carrying out divisional operation orders.

During the combat the G.O.C. division continues to command the divisional artillery, except when the whole or part of this is specially handed over to the C.R.A. The latter has a free hand as regards minor movements, just as an infantry brigadier has a free hand in the disposition of his battalions. But all artillery movements or operations on the large scale are ordered or sanctioned by the G.O.C., and are embodied as soon as possible in the operation orders issued during the combat,[1] in order that the infantry may know what the artillery are doing.

Even when the divisional artillery are not specially handed over to him, the C.R.A. retains the general control and direction of their fire, so far as circumstances permit. He may not be able to establish direct and immediate communication with his brigades, and he may not know what is going on at every point of the line of battle. But he will generally be able to allot target areas, and, so far as possible, he

[1] At manœuvres a battle is over in a few hours, and operation orders during the combat are seldom issued. On service a battle may take several days.

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should endeavour to realize the ideal of the massed fire of dispersed units.

When the divisional artillery, or part of it, is handed over to the C.R.A. for a special purpose, this is notified in operation orders. He then issues his own orders.[1] A section of the divisional communication company is handed over to him, and he establishes his own communications independently of the divisional communications. He is then the absolute fire commander, and every shot is fired in accordance with his general or particular orders. His own station, and the positions of the artillery brigades, are selected with regard to massing fire, and especially to bringing an enveloping fire to bear on important points. He orders all movements of artillery units, and his brigade commanders no longer receive general orders "to act in support of an attack," but definite orders as to how they are to do it.

The system of placing the C.R.A. in independent command of the divisional artillery is suitable for the deliberate attack or defence of a position. In encounter, pursuit, or retreat, or in any running fight where both sides are on the move, it is inapplicable. By the time the C.R.A. had laid his telephone lines and prepared his fire-charts, the tide of battle would have shifted elsewhere and he and his brigades would be left to contemplate an empty landscape.

[1] It is desirable that copies of these should be communicated to infantry brigadiers.

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Duties of the C.R.A.

The officer commanding the divisional artillery rides with the G.O.C. on the march, and accompanies him throughout the action. In camp or billets he is quartered with the divisional staff. If, during the action, he has to leave the G.O.C. on some special duty, such as an artillery reconnaissance, he leaves his staff captain to represent him.

He advises the G.O.C. as to the strategical disposition of the artillery, and submits to the Chief Staff Officer of the division draft orders as to the distribution of the artillery and tasks assigned to them, to be included in operation orders. He accompanies the G.O.C. in his reconnaissance of the battlefield, and advises him as to the tactical employment of the artillery and the general situation of the artillery positions. Subsequently, if time permits, he will carry out a more detailed reconnaissance himself, directing the artillery brigade commanders to meet him at certain points and to accompany him within their own sections.

During the action the C.R.A. receives orders from the G.O.C. as to the tasks to be fulfilled by the artillery, and gives orders to his brigades accordingly. He communicates with them either direct by signal or orderly, or by the divisional communication lines.

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Communication between the C.R.A. and his Brigades.

This is carried out, in principle, through the divisional communication company, the organization of which is described in Chapter XIII.

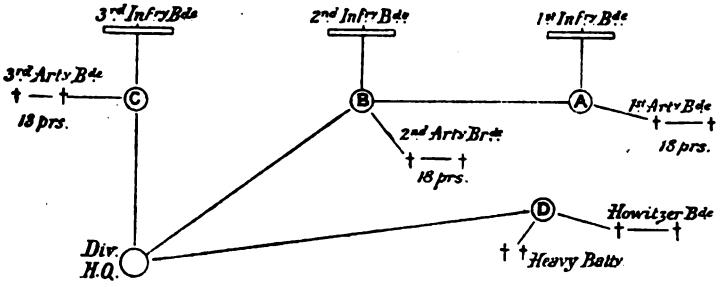

FIG. 103.

The above diagram shows an ordinary scheme of communications in the division. The divisional communication company establishes the four stations, A, B, C, and D, and lays the lines to them, and the infantry and artillery brigades connect themselves with these stations by their own telephones. In the diagram, A and B are shown on the same line; but putting several stations on one line should be avoided, if possible, as the line gets choked.

In the German army, **communication centres** are established, to which all reports are sent, and the position of these is notified in operation orders.

Orders during the Combat.

After the action has commenced, the orders received by the commanders of artillery brigades

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already in position will usually be of a general nature, such as "Support 1st Infantry Brigade attack on point 341." An order of this nature implies a good deal. The artillery brigade commander has first to place himself in communication (personal, if possible) with the O.C. 1st infantry brigade, who informs him of the method and time of the attack. He may have to shift his position to support the attack: if so, this should be immediately reported to divisional headquarters,[1] and to adjoining artillery brigades, if in communication with them. The brigade commander has further to send forward sections in close support (see Part IV.) if this is necessitated by the nature of the country; he has to keep up communication with the infantry during the attack, and to support it by his fire. Unless in direct communication with C.R.A., he must himself decide whether to push forward to a fresh position as the attack gains ground, whether to send batteries forward at a trot to crown the captured position, and whether to pursue. All this is covered by the original brief order to support the 1st brigade. It will be seen that a good deal of initiative is required of the artillery brigade commander.

At the beginning of the combat, it is not usually advisable for an artillery brigade commander to occupy a position without orders, and to open fire on

[1] Unless the C.R.A. has a telephone line of his own, all artillery messages are directed to the code signal for divisional headquarters (as "K Toc") and addressed to "Div. Arty." In most foreign armies the direction and address would be simply D H Q, or the equivalent letters.

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his own account in support of the infantry, as this may interfere with the G.O.C.'s scheme. But this is fully justifiable when matters are urgent, or when it is impossible to communicate with headquarters in time. In a battle of encounter, before communications are established, it may be a case of "shoot first and ask afterwards." Every commander, in his degree, must do his best to carry out the G.O.C.'s intentions, as embodied in operation orders; and if he does the wrong thing on emergency, this is still a great deal better than doing nothing at all. In any doubtful case the artillery brigade commander can always offer his assistance to the brigadier-general commanding the nearest infantry brigade. When he acts without orders, the artillery brigade commander must immediately report his action to divisional headquarters.

Detached Forces.

When artillery is sent with a force detached from the division, the senior artillery officer becomes the C.R.A. of that force and joins the staff of the commander. On the small scale, he commands his own unit as well. The advanced guard, for instance, may be considered a detached force in this sense. A case which frequently occurs is when an infantry brigade is ordered to carry out some special operation, such as to cover the disentraining of the division, and artillery is attached to it for the purpose.

When an artillery unit is ordered to support a particular infantry unit, this does not constitute

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attachment, unless so stated ; but the artillery commander must place himself in communication with the infantry commander, and must keep in touch with him, in order that the two arms may work together.

Command in the Brigade.

Within the artillery brigade, command is a simple matter. The lieutenant-colonel commanding issues orders to the three majors through his adjutant. He has also an orderly officer who assists the adjutant. In action, he communicates with the battery commanders by the brigade telephone, which is laid, if possible, before the batteries come up. When the whole brigade is in action in line in the open, the brigade commander usually stands in one of the two intervals, where he can give orders personally to two of the battery commanders, and can send messages to the third, or can pass orders down the brigade, which are repeated by the section commanders.

Command in the Battery.

This is usually direct by voice. When the battery is in the concealed position, with the battery commander observing at a distance, he sends executive orders by telephone or flag to the senior section commander, who falls out from his section (leaving the senior No. 1 to command it) and stands in rear of the centre of the battery. When communicating by flag, **double chain** is usually employed. That is, a

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pair of "red" signallers send and receive orders *to* the battery, and these are repeated back to the battery commander by a pair of "blue" signallers, which ensures that all orders have been correctly received and acted upon. A code (laid down in F.A. Training) is used for all the routine orders; for instance, "empty guns" is MT. The method of signalling varies according to the light. Semaphore signalling is quickest so long as it can be read without glasses; beyond this distance Morse is quicker. But it is not always possible to conceal the flag from the enemy, and semaphore with the arms, read with glasses, may have to be used. When the heliograph can be used, it is even quicker than the telephone for code signals. When these are sent by telephone, the signalling names of the letters are used; thus MT is "emma toc," and AP (aiming point) is "ac pip." This also applies to spelling names of places on the telephone; thus Bath is beer-ac-toc-aitch. It may be noted, in this connection, that the R.E. signallers of the telegraph companies, though they always use the telephone, never talk into it; they send Morse on the buzzer at about 20 words a minute, which is practically as quick as talking, and much less liable to error. But artillery operators, though they can send and receive on the buzzer when the line is bad and hearing indistinct, are not usually capable of more than 10 words a minute.

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CHAPTER XV.

RECONNAISSANCE.

THIS term covers a great variety of operations. Taking them in the order in which they occur, we have first the strategical reconnaissance, to discover the position of the enemy's armies and bases; this has nothing to do with artillery. Next comes the distant tactical reconnaissance, carried out by the cavalry or divisional mounted infantry, sometimes accompanied by artillery officers; this in future may possibly be carried out by aeroplanes. Next, from an artillery point of view, we have the reconnaissance by artillery officers' patrols, covering a distance not usually exceeding 5 miles. This is followed by the reconnaissance of the battlefield and the positions, carried out by the G.O.C. with the C.R.A., and by the senior artillery commanders and their staffs; the target reconnaissance from the positions, by all artillery commanders; and finally the reconnaissance of the enemy during the combat. Occasionally reconnaissance from captive balloons and man-lifting kites is possible. The term reconnaissance may also be held to include **scouting**, which is reconnaissance in the immediate vicinity of artillery units, up to

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distances of about 400 yards, carried out by mounted N.C. officers.

The Distant Reconnaissance.

The action of the horse artillery with the cavalry brigade is considered in Part IV. The distant reconnaissance for each division is the business of the divisional mounted infantry. Artillery patrols should not be employed to do the work of the mounted infantry, but it may often be advisable, on the eve of an engagement, to send forward an artillery officer with the divisional M.I. He will have no time for detailed reconnaissance, but he will be able to note the general nature and lie of the ground as affecting artillery action, and the situation of the principal artillery positions. He should not remain out with the M.I., but should rejoin his unit before the battle.

Artillery Patrols.

The C.R.A. of a division will usually call for two artillery patrols from his command; sometimes, in very difficult country, for one from each brigade. These will join his staff at the commencement of the fighting march; sometimes, however, they will be required on the preceding evening, to reconnoitre from the outpost line. If possible they should rejoin their brigades before these come into action, but it may be necessary to keep them out during the combat.

The artillery **officers' patrol** consists of one officer, one mounted orderly (a signaller if possible) and one

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horseholder. The general idea of the employment of these patrols is as follows: On approaching the enemy the C.R.A. sends forward two patrols along the road by which the divisional artillery is marching, to reconnoitre possible artillery positions. One patrol takes the positions on the right of the road, the other those on the left. The officer of a patrol is not expected to execute a detailed reconnaissance of a position, nor to send back sketches and reports. It is sufficient if he marks good positions on the map, and is able to guide a brigade into any one of them. He notes anything that is to be seen of the enemy. If he obtains important information he may send a report back by orderly; but usually he goes on until the advanced guard is checked by contact with the enemy, and then awaits the C.R.A. on the road with his report.

Officers' patrols are very useful, especially in a close country, and save the C.R.A. a great deal of riding about. If the C.R.A. has to spend his time riding round the country looking for positions, he cannot be at hand to advise his G.O.C. The only objection to the use of these patrols is that the batteries can ill spare them; however, it ought to be possible for them to rejoin their own batteries before these come into action.

The next phase is the reconnaissance of the battlefield by the G.O.C. division, accompanied by his C.R.A. According to circumstances, this may be a detailed inspection of the whole front from a motor car, or a glance at the country from the top of a hill.

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Perhaps in future it may mean a balloon ascent. When good maps of the country are available, there is little for the G.O.C. to learn from an inspection of the minor features of the ground, and his reconnaissance will not take many minutes. The points for the C.R.A. to look to are, first, the general situation of the main artillery positions; secondly, the available **positions of readiness** into which the artillery can move, while their fighting positions are being reconnoitred.

If time permits, the C.R.A. now makes a more detailed reconnaissance of the artillery positions. He leaves his staff captain with the G.O.C., and takes with him his orderly officer and the two officers of the patrols who have already been over the ground. The staff captain sends instructions to the brigade commanders to meet the C.R.A. either at the positions of readiness which have been selected, or at the fighting positions.

Before a deliberate action, such as the attack or defence of an entrenched position, a most thorough and careful reconnaissance of the ground will be necessary, especially if the batteries are to move into position by night. The tactical points involved are dealt with in Part IV. The technical points are considered in Chapter XIX.; generally speaking, it may be said that the important points about an open position are a good field of fire and, if possible, concealed approaches; about a concealed position, an observing station affording a good view, concealed approaches, and good concealment for the guns.

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The C.R.A.'s own station will be with the G.O.C., who will naturally select the station affording the best view of the battlefield.

The brigade commanders, in addition to reconnoitring the positions assigned to them, and the approaches, have to carry out a **target reconnaissance** before their brigades arrive. The C.R.A. will already have generally reconnoitred the target area, and will probably have allotted a section of the target to each brigade. The brigade commander has now to consider how he can most effectively deal with existing or prospective targets in this section. This is principally a question of observation of fire. He may have to send out flank or advanced observing parties to get a better view. For instance, if there is a hollow in his target section into which he cannot see, but which, from the map, should be overlooked from a point half-a-mile to his right, he may have to send an officer to that point. Any visible target is carefully examined with the telescope, preferably from two different points of view, and is located on the map; if guns are visible, the probable position of the limbers and teams can often be deduced. Special attention must be directed to all points in the enemy's line which afford a good view of the battlefield, and preparations must be made to smother them with fire if any staffs appear on them.

Reconnaissance during the Combat.

The C.R.A. and his staff keep the target area under observation, but in ordinary close country it will be

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impossible to see the whole combat from any one point. To a great extent the C.R.A. will have to depend upon reports from his own brigade commanders, and upon the reports from the fighting line which reach the G.O.C. He may possibly be able to supplement these reports by information from his artillery patrols (in case he has retained them) sent out to advanced observing stations. But as all good observing points will already be occupied by our own troops, he is not likely to get much additional information in this way. Broadly speaking, it may be laid down that, so far as the C.R.A. is concerned, a special artillery observation service is not worth establishing, especially with the limited means at his disposal. The reports of the combat which reach divisional headquarters should not be infantry reports or artillery reports; there is no reason for making any distinction between the two. They should be combat reports, upon which the joint action of the different arms is based. The old conception of the artillery as a separate arm, controlled by a specialist officer with an intelligence service of his own, is inconsistent with the modern system of combined tactics. And if we cling to this obsolete idea, we shall never get gun and rifle to work together.

The brigade commander's reconnaissance during the combat is carried out with telescope and field-glasses from his observing station. Under favourable circumstances he will be able to watch the movements of our own infantry throughout the combat; even if he cannot locate the enemy opposing them, he can at

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least search the ground in front of our infantry whenever they are checked. When the brigade commander cannot keep our own infantry under observation himself, it is absolutely necessary that he should be informed as to their movements. This involves a question of combined tactics which will be more fully dealt with in Chapter XXIII. Briefly, the brigade commander must in any case keep up communication with the commander of the infantry brigade which he is supporting. And, in addition to this, he may have to push forward a patrol to a point where they can signal back direct to him information of what is going on in the firing line, and in front of it. The best position for such a patrol is certainly not in the firing line, but rather at a point which commands a view of the firing line, and such that a signal station communicating with the brigade commander can be established at or near it.

During the combat, the brigade commander will also reconnoitre positions to which he may have to advance or retire, and the approaches to them. He may find it necessary to send an officer to select such positions; this will usually be advisable in a retirement.

The battery commander's target reconnaissance is similar to the brigade commander's, on a smaller scale. He must have a good view of his target, and must be able to observe his fire. If he cannot do so he sends out an advanced or flank observing party to assist him; but before doing so he should

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ask leave of the adjutant, as it is not desirable that each battery should send out an observing party where one for the brigade would suffice.

Reconnaissance Reports.

The general system of framing such reports is dealt with in F.S. Regulations, Part II., and it is here only proposed to give a few notes on matters specially affecting the artillery.

The great point to attend to is to give the officer to whom the report is rendered the information that he wants, and as little else as possible. For instance, in reporting on a road by which the artillery are to march next morning, it is quite unnecessary to go into details as to the material available for repairing it, or the nature of the bridges, so long as these will carry the guns. On the other hand, if the horses are to be watered during the march, the C.R.A. will want full information as to the watering facilities, and an enlarged sketch of the watering place, showing the proposed watering arrangements, will not be out of place. If there is an awkward turning where the leading battery might go astray, a very simple sketch in the margin may save trouble.

FIG. 104.

Very little mapping will be done on service, and when a plan of a road or position is required it will be enlarged from the map, ruled in squares for the purpose.

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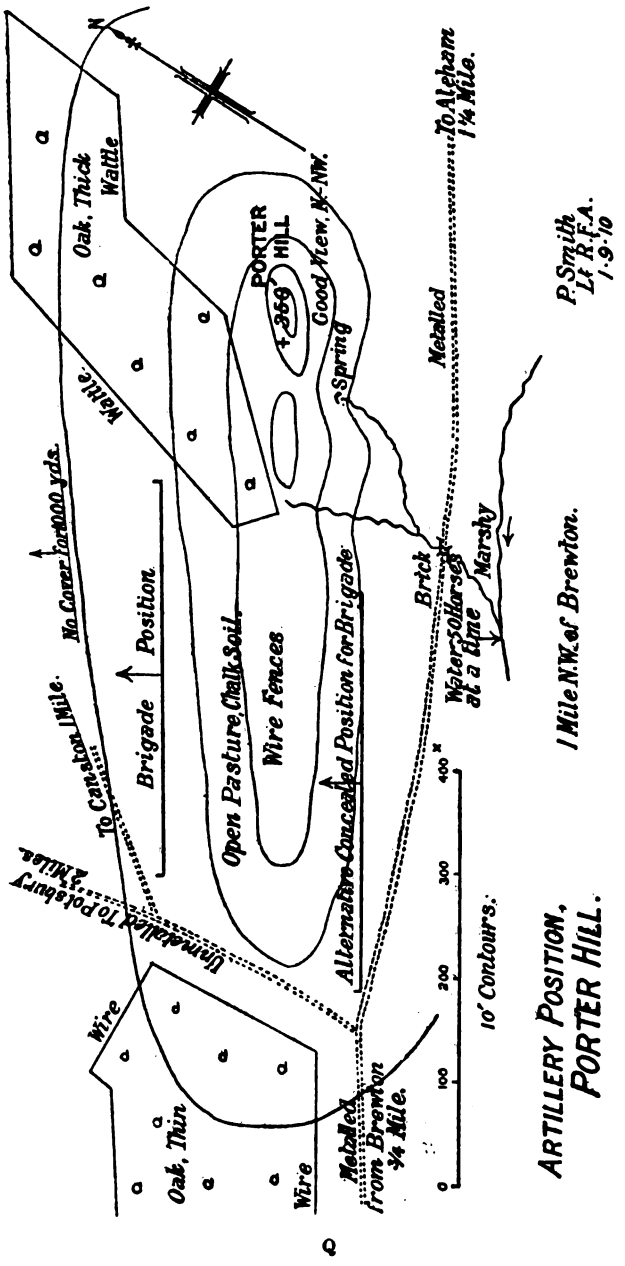

FIG. 105.

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When a sketch is sent in, a separate report should be avoided if possible; the endeavour should be to give all necessary information on the sketch or at foot of it. The sketch and report will have to be read by a busy staff officer, probably by candle light, and it is advisable to make things as easy for him as possible.

An example of a sketch of a position is given in Fig. 105. On comparing it with the plan of the same position in Fig. 58, it will be noticed that, though much rougher, it gives more information. The places where the roads lead to, and the distances, are inserted; the watering arrangements are shown; and there is a note to the effect that the soil is chalk. This is important, because it takes twice as long to entrench on chalk as on any other soil, owing to the necessity of carefully covering all parapets and excavated chalk with turf, as they would otherwise make conspicuous targets.

A **panorama sketch** taken from the outpost line is given in Fig. 107. No great artistic skill is needed to make a sketch of this kind; in fact the best artists sometimes make the worst sketches, as they waste time in drawing "rabbits in the foreground," and neglect detail of military importance.

A panorama of a different kind is given in Fig. 106. When the batteries of a brigade are dispersed in positions, say, a quarter of a mile apart, the foreground, as seen from the flank batteries, has not the same appearance as from the brigade commander's position in the centre. Each flank battery therefore

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executes a panorama sketch in duplicate, and sends both sketches to the adjutant. The adjutant letters all important points on both sketches, and sends one

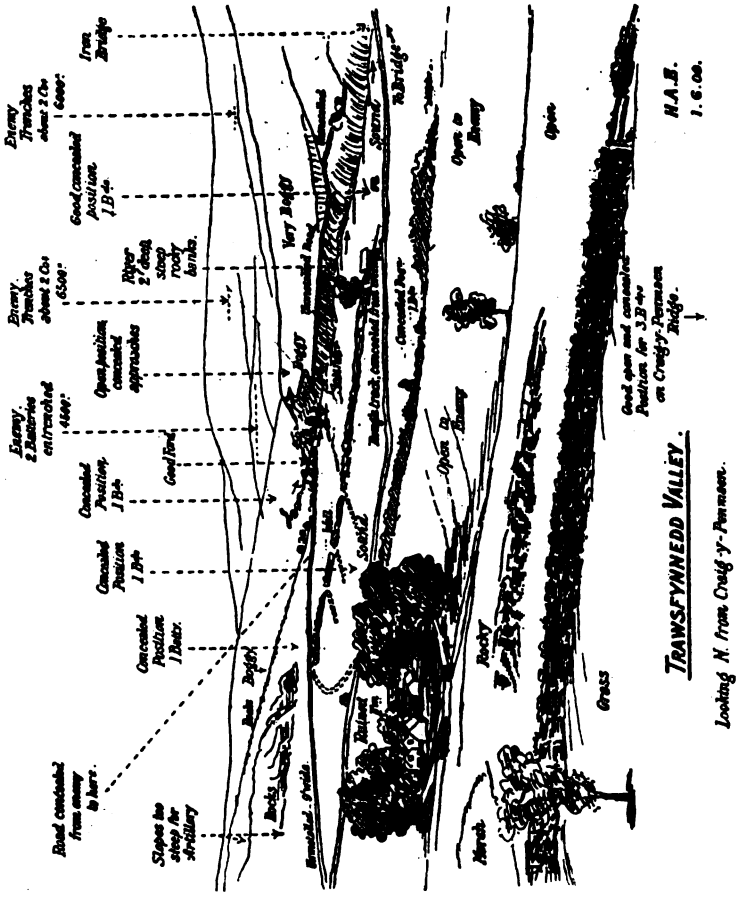

FIG. 107.

copy back to the battery. Then if it be required to turn the fire of the battery on to a given point, the order "Engage F" is sufficient.

The same panorama also serves another purpose when the battery is in the concealed position. The

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horizontal angle with reference to the original line of fire of the battery, the angle of sight, and the range, are recorded on the sketch for each possible target. Then if the battery commander is ordered to engage a target at point I, he looks at the panorama and orders "All guns 7° more right; angle of sight + 1°; 3600-3900." Similarly, the battery commander may be able to report to the adjutant,

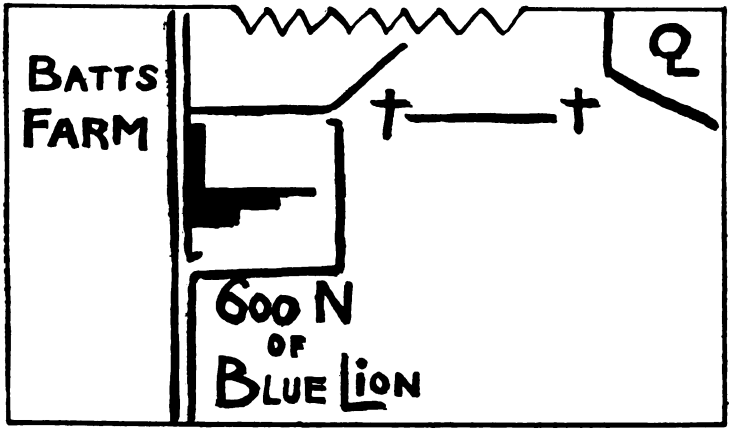

FIG. 108.

"Have located trench between F and G," instead of sending a long message describing its position.

A reconnaissance sketch for use **by night** must be simple in detail and bold in style.

The specimen in Fig. 108 is intended to be given to a battery commander to assist him in leading his battery into position at night. It is executed with a brush on white cardboard; the notches at top are of assistance in holding the sketch the right way up. The original sketch measures 12 in. × 7 in.

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Reconnaissance from Balloons.

Reconnoitring from a **captive balloon** is less easy than is generally supposed, as the vibration caused by the rope renders it difficult to use glasses. Considerable training is required, and a staff officer sent up for the first time will probably see a good deal less than he expects. Reconnoitring from a **dirigible** is much easier. But in view of the difficulty of keeping these great machines in the field with an army, it is unsafe to reckon upon their assistance.

Considerable progress has been made in **photography** from balloons. A central camera, surrounded by six subsidiary cameras, is used, and an instantaneous photograph is taken. The seven plates are then set in a holder at angles such that when a fresh photograph is taken of them the result is a correct map of the ground. The diameter of the circle covered by the photograph is five times the height of the balloon.

Reconnaissance from Aeroplanes.

The possibilities of the **aeroplane** in reconnaissance were demonstrated at the French 1910 manœuvres, when 20 aeroplanes were employed. It is stated that very complete information as to the positions of the opposing artillery and infantry was obtained, and that the observer accompanying the aviator was able not only to mark the position of troops on his map but to form a reliable estimate of their numbers. It must be remembered, however, that

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these aeroplane trials were carried out in summer. A week of winter storms would probably oblige the whole of the air-craft of an army to lie up for the time. Therefore it is at present premature to assert that the aeroplane will entirely supersede cavalry for reconnoitring.

As a result of these manœuvres, the French made arrangements to provide 60 aeroplanes for their army, to be ready by the end of 1910, and to train 200 officers as airmen. The French service pattern aeroplane is a biplane capable of carrying three persons, though only two, the aviator and an observing officer, will ordinarily be carried. The observing officer is armed with a repeating rifle for shooting at hostile air-craft. The biplane is capable of 37 miles an hour, and carries petrol for 186 miles.

Special maps are used, enlarged from the Staff map and brightly coloured. All unnecessary detail is omitted, and prominent landmarks, such as church spires, are clearly marked.

Man-lifting kites are occasionally useful for reconnaissance, especially when the wind allows of their being flown towards the enemy. The observing officer communicates with the officer at the kite-cart by telephone or by flag-signalling. He stands in a basket reaching to his armpits, which gives him full liberty to use his arms. In the deliberate attack of a position valuable information may be obtained in this manner.

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Scouting.

This term is used to signify reconnaissance in the immediate vicinity of the battery or brigade. Thus when a battery crosses rough ground it is preceded by a pair of scouts who pick out the best points for crossing difficult places, and call attention to swamps or other obstacles. In unknown country scouts are sent ahead of the column to find the way. In action, scouts are employed to search any cover in the vicinity where an enemy might be concealed, and to keep a look-out for the unexpected approach of an enemy from the flank or rear. Scouts cannot be spared from the fighting battery, and are taken from the mounted non-commissioned officers with the wagon line.

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CHAPTER XVI.

CAMPS AND QUARTERS. OUTPOSTS.

General.

In a campaign in Northern Europe, there are not more than two months in the year when the men can lie out, night after night, without shelter. If troops have to bivouac several nights running in winter, the sick list, especially among the reservists, will be very heavy. With a large army, it is impossible to provide tents, if only because the expense of keeping up tentage for the whole army in peace-time would be prohibitive. Billeting is therefore the normal method.

Billeting.

The method employed in peace-time, when a single battery marches through a town, is to billet the men and horses on the publicans. This accommodation would, of course, be insufficient under war conditions, and troops will then be billeted on all the inhabitants. The general idea is that the troops occupy all rooms on the ground floor, leaving the inhabitants the use of the upper stories. A rough rule is that a house will accommodate one man per yard of front.

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According to this, a division, which consists of about 19,600 men (including transport), would require some eleven miles of house-frontage, the divisional artillery (about 4000 men besides the divisional ammunition column) would require 2¼ miles, and a single brigade (960 men) would require over half a mile. When this is not available, **close billets** are resorted to. That is, the troops occupy all ground-floor rooms and outbuildings, each man being allowed only sufficient floor-space to lie down; thus a room 12 ft. square accommodates twelve men. At this rate a house will take about four men per yard of front, besides men bivouacking in the garden.

It is quite impossible to provide **stabling** for all the horses of an army. Outbuildings will be used as far as possible, but most of them will have to stand out. If protected by thick rugs they will not suffer much from ordinary winter weather.

Guns will be parked in open spaces such as village greens or market places. It may be necessary to park them outside a village. The artillery will occupy the billets nearest to their guns, and, as a rule, the horses will have to be picketed close to the guns. If they were stabled they would have to be scattered over a large area, which is inadmissible when within striking distance of the enemy. It may sometimes happen that guns and horses will have to stand in the street, just as they were halted, the horses being unharnessed and tied up to the gun-wheels.

When billets (not close billets) are occupied only for a single night, the inhabitants may be called upon

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to victual the troops. Otherwise they will have to be rationed as usual. In towns, forage rations for the horses will always have to be issued.

Artillery units will be quartered, as far as possible, in villages and farms, where forage and, to some extent, shelter for the horses are available. Being more mobile than infantry, they will be quartered at a greater distance from the line of march, and may have three or four miles to cover before they join the column of march next morning.

Camps and Bivouacs.

Each battery of artillery is allowed a camping space 75 yards by 150. This usually means that the front is restricted to 75 yards. The guns are in front, either limbered up or in action, and the horses are tied up to picket ropes stretched between the wagons.

Three methods of picketing horses are shown in Fig. 108 A. At A, the horses are picketed in single lines, which enables them to face with their tails to the wind. The gun limber is pegged down in front, and picket lines stretched back to the two ammunition wagon limbers and bodies; the latter have the brakes put on. The method shown at B is suitable when more front and less depth is available. That shown at C is frequently used in peace-time, but it is not so suitable for hooking in in the dark, or in a hurry, as the other methods. Horses are usually picketed six feet apart, but in very cold weather they should be closer. Each horse's harness is piled behind him. The officers and men are in rear of the horses,

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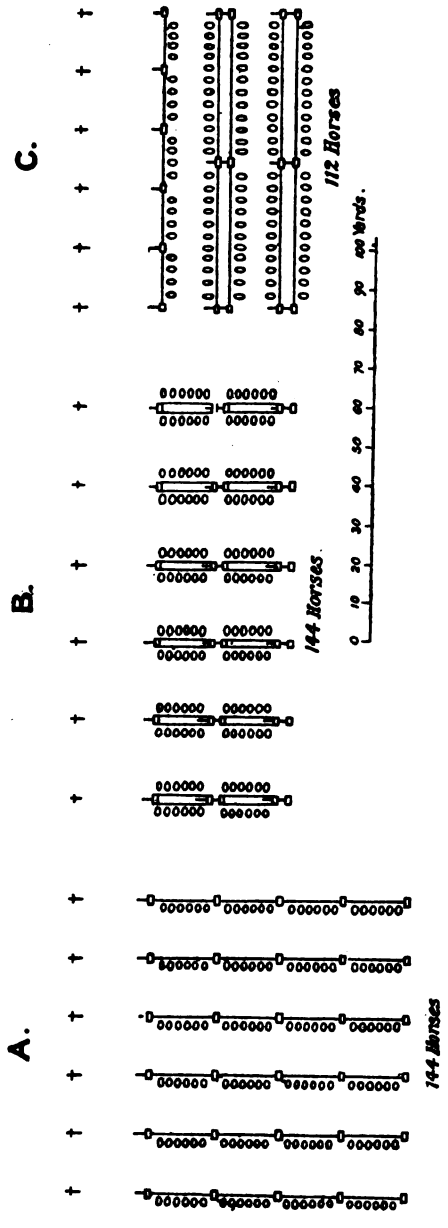

Fig. 108 A.—Methods of Picketing Horses.

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but when no tents or shelter are available the men get under the wagons, fixing the gun blankets over the wheels and poles, and they are thus able to make themselves fairly comfortable. A G.S. wagon makes an excellent shelter if the canvas cover be extended to windward by three sticks as in the figure.

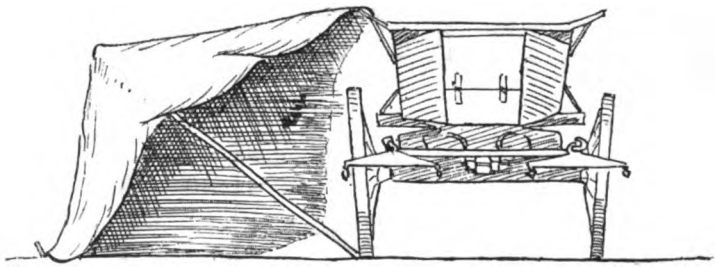

Fig. 109.

In encamping a **mixed force**, the points to be remembered are to put the infantry nearest to the enemy, the mounted troops nearest to the water, and the latrines as far from the water as possible.

OUTPOSTS.

When outposts are employed merely to guard the main body against surprise, or against annoyance by small parties of the enemy, there is no object in putting guns in the outpost line.

When the outposts are intended to fight if attacked, and give the main body time to form up, guns may occasionally be useful. Thus if a bridge or other defile is visible, which the enemy will cross if he attacks, a section of guns may be kept ready to fire

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on it. Or if there are important positions in front, out of rifle range, guns may be used to prevent the enemy from occupying them.

When it is intended to hold the outpost line as a defensive position in case of attack, artillery positions should be selected, ranges taken, and preparations made for opening fire, but it is not usually advisable to bring the batteries into position beforehand. It is preferable to encamp or billet the artillery, say, a mile in rear.

Artillery are useless in the outpost line **at night**, except in the rare cases when they can fire at night. For instance, guns may be layed by day-time on a railway station, and fire opened if the enemy are reported to be disentraining there. Or an important defile may be illuminated by searchlight to enable the guns to keep it under fire.

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CHAPTER XVII.

MARCHES.

General.

The marching power of artillery varies according to the condition of the horses and the state of the road. When both are good, a field battery can march 120 miles a week without loss of efficiency. Thirty miles in a day is a good performance, forty is about the limit, and the horses will require a day's rest after it. It saves the horses to trot when the road is good and level, or slightly downhill, provided that this can be done without sweating them or raising clouds of dust which gets under the harness and produces galls.

A brigade of artillery, without ammunition column, occupies two-thirds of a mile of road; hence in undulating country part of the brigade will be going uphill, part downhill, and the pace of the whole will have to be that suited to the steepest portions of the road. The ideal method is therefore to march batteries at one hour intervals and sections at ten minute intervals; but this is rarely possible in war.

Horses should be watered once in a 20 mile march, but it is very rare to find a watering place

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1200 yards long, allowing a whole brigade to water simultaneously. Therefore either the rear batteries must halt while the leading ones water, taking 20 minutes each, or else the batteries must be timed to arrive at the watering place at 20 minute intervals.

On the level, infantry march 3 miles an hour, artillery 4; uphill the artillery, on moderate slopes, march $4\frac{1}{4}$ miles an hour (because every horse is pulling hard), while the infantry pace is reduced to $2\frac{3}{4}$ miles; downhill the artillery march only $3\frac{1}{2}$ miles an hour, while the infantry step out and do $3\frac{3}{4}$ miles. Therefore if artillery and infantry march along the same road, with only 25 yard intervals between them, considerable discomfort must ensue to both. If possible, the artillery should have a road to themselves, or should follow the cavalry.

The Fighting March.

The above considerations refer to marches at a distance from the enemy. When contact with the enemy is possible, the troops must march in fighting formation and the artillery must conform to the infantry pace.

As an instance of a fighting march, we will take an infantry division marching along a single road. With our own small forces, we should probably use two roads at least; but when great masses of troops are employed, as on the Continent, 20,000 men on a road is nothing unusual.

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MARCH OF AN INFANTRY DIVISION.

VAN GUARD.

2 companies M.I.
½ company infantry.
1 section R.E.
1 detachment communication company.

Interval of 3 miles.

MAIN GUARD.

O.C. advanced guard.
C.R.A. of advanced guard.
1 section communication company.
1 battalion, less ½ company.
1 battery, less first-line wagons.
1 battalion, less ½ company.
1 section R.E.
First-line wagons of battery.
½ company.

Interval of 3 miles.

MAIN BODY.

½ company.
G.O.C. and staff.
C.R.A. and staff.
1st echelon communication company.
1 infantry brigade, less 2 battalions and ½ company.
4 artillery brigade commanders and 1 heavy battery commander and staffs.
4 artillery brigades, less 1 battery, and 1 heavy battery, less first-line wagons.

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2 infantry brigades, less 1 battalion.
2 field companies R.E., less 2 sections.
First-line wagons of artillery.
Ammunition columns of artillery brigades and heavy battery.
2nd echelon communication company, less detachments with advanced guard and rear guard.

REAR GUARD.

1 detachment communication company.
1 battalion.

In the above marching formation of a division, there are several points affecting the artillery. Only one battery is shown with the advanced guard, which is merely a protective one. If the G.O.C. wishes his advanced guard to fight and seize positions for him, it should have two batteries, or even a brigade with it.

No flank guards are shown. If these are employed, then a flank guard intended merely to keep small parties of the enemy at a distance should have a section of guns with it. If it is to fight larger bodies, it should have a battery with it.

The rear guard in this instance is merely to pick up stragglers and keep off raids of small mounted parties on the rear of the column. A fighting rear guard, employed in a retreat, is a strong force of all arms, and may be as much as one-quarter the strength of the column.

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It is rather a moot point in foreign armies whether the G.O.C. and C.R.A. should not ride with the advanced guard, especially when a strong fighting advanced guard is employed. The G.O.C. will probably settle the point by fixing his official position at the head of the main body, and going forward in his motor car for a personal reconnaissance, taking the C.R.A. with him, when the first news of the enemy is received. The chief staff officer will remain behind with the divisional staff to represent the G.O.C.

All the artillery brigade commanders and their staffs ride together at the head of the divisional artillery.

The communication company is divided into two echelons. Two of the three field telegraph sections, the lamp station, and the wireless station are in rear of the ammunition columns. It might also be advisable to march the pontoons of the R.E. field companies in rear, as these are apt to block the road.

No baggage guard is shown, it being assumed that this is found by other troops attached to the division, otherwise a battalion would be required for this purpose.

The question of the position of the R.A. first-line wagons in the column has already been discussed under *Organization*. In this instance, by sending them to the rear, the 2nd and 3rd infantry brigades are brought nearly a mile nearer to the head of the column, saving 20 minutes in deploying.

If any horse artillery were attached to the division, they would be employed with the advanced and flank guards.

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Distances on the March.

Field artillery brigade of three batteries, with brigade staff and first-line wagons	1200	yards.
The same, fighting batteries only	835	„
Horse artillery brigade of two batteries, with brigade staff and first-line wagons, detachments rear[1]	940	„
The same, fighting batteries only	810	„
Field battery, with staff and first-line wagons	385	„
Fighting battery only	265	„
Horse battery, with staff and first-line wagons, detachments rear	505	„
Fighting battery only	385	„
Heavy battery of four 60 pr. guns, with staff and first-line wagons, including two store wagons and 14 spare horses	333	„
Fighting battery only	205	„
Mountain battery, with staff and ammunition line, in column of route	1145	„
The same, column of sections (wide roads only)	600	„
Fighting battery only	255	„
The same, column of sections	135	„

Ammunition Columns.

Field artillery brigade A.C.	1180	yards.
Horse artillery „ „	765	„
Heavy battery A.C.	155	„

Second-Line Transport.

Field artillery brigade transport	205	yards.
„ „ „ A.C. transport	70	„
Horse artillery brigade transport	200	„
„ „ „ A.C. transport	85	„
Heavy battery transport	40	„
„ „ „ A.C. transport	15	„

Under peace conditions a column of artillery opens out very little on the march. But in war-time, when the horses are poor, at least 10 per cent. should be allowed.

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[1] With detachments right or left, the distance is only 820 yards, or 570 yards without first line. But there would rarely be room for this on an ordinary road.

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Assembly for the March.

This involves an elaborate piece of staff work which does not directly concern the artillery. Each unit has to march from its quarters by the shortest road to its place in the column, and the times of arrival have to be calculated so that each falls into its place without checking the rest. It is not advisable to let all the units join the column at one place, as at A, as there will be a bad block there; they should fall in by successive cross roads as at B. The artillery brigade commanders and staffs will have to trot past other artillery brigades to get to their places at the head of the divisional artillery, but this is a minor matter.

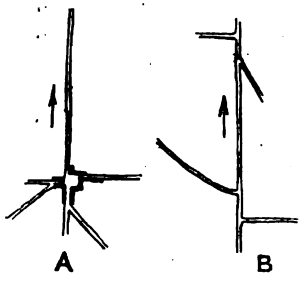

FIG. 110.

The artillery officers' patrols will join the C.R.A. at his starting point.

The question of **deployment** from the column of march is treated in the next chapter.

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CHAPTER XVIII.

MANŒUVRE.

Field and Horse Artillery.

The **fighting battery** consists of six guns, each accompanied by its wagon; the remaining six wagons constitute the **first-line wagons**, and follow about half a mile in rear. The formations of the battery are **line**, with the six guns, each closely followed by its wagon, at intervals of 20 yards; **echelon**, with the centre section 20 yards in advance of the line; **battery column**, with the three sections following one another closely; **column of subsections**, with the six guns, each with its wagon on its right or left, following one another; and **column of route**, with the six guns, each followed by its wagon (or two wagons) following one another in a long column.

Line is used when advancing across the open under fire; echelon is easier to lead, especially when the ground is rough. Battery column is the normal formation in the open. Column of subsections is used in coming into action to a flank, in positions which cannot conveniently be approached in line; it is the normal method of coming into action in the

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concealed position. Column of route is used on the road. Line at **close interval** is a ceremonial formation.

In the **brigade**, the formations are **line**, **echelon** (the centre battery 40 yards in advance of the line), **line of battery columns** at 125 yards interval, and **mass**, which is line of battery columns at 45 yards interval, that is, with intervening spaces of 25 yards. Occasionally **column of sections**, in which the three battery columns follow one another, is used. Mass is the usual formation of assembly, and column of route is used on the road.

The pace of manœuvre is the trot of eight miles an hour, but field batteries do little trotting on service, except when deploying from the column of march. Horse artillery can gallop at 15 miles an hour for about two miles when the ground is good; field artillery can gallop for about one mile on emergency, but the horses, especially the wagon teams, are likely to be badly blown. After a month's campaigning none of the artillery draught horses are likely to have much gallop left in them.

Heavy Batteries.

These rarely work in brigade. The fighting battery consists of four 60 pr. guns, or (in foreign armies) 6 in. howitzers, each drawn by eight heavy horses or by motor tractors. Each 60 pr. is followed by a wagon drawn by four horses. Each battery has a telephone wagon. The usual formation is column of route, and the pace the walk. The first-line wagons are usually

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transport wagons; they include two wagons with technical stores.

Mountain Batteries.

These are nearly always employed singly. The battery is divided into a **gun line** and an **ammunition line**. The gun line consists of six guns (5 mules to a gun) and 12 ammunition mules. The ammunition line consists of 36 ammunition mules, 30 relief mules, and mules carrying entrenching tools and stores. There are also 30 reserve mules per battery, usually in second line. Each subsection of the gun line marches in the following order: Axle mule, wheel mule, carriage mule, breech mule, chase mule; this being the order in which the parts of the equipment are required when putting the gun together for action (called "unlimbering,") which takes less than one minute. A mountain battery usually moves in a column of single mules, called **column of subsections**, the gun line being followed by the ammunition line. **Battery column**, as in field batteries, is used on open ground. On the march **column of route** is used, in which each subsection moves complete with its ammunition line. On wide roads **column of sections** (two subsections abreast) may be used.

The pace is the walk of four miles an hour, and the gun line can trot for a short distance, the men running.

Deployment from the Column of March.

At or before the order to deploy, the C.R.A. rides forward with the G.O.C. to reconnoitre (see

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Reconnaissance). The C.R.A.'s staff captain calls up the brigade commanders and staffs. When the C.R.A. returns he takes the brigade commanders with him to reconnoitre, or directs them where to meet him. He orders the divisional artillery to trot on to the position or positions of readiness which he has selected, using his officers' patrols, if necessary, to guide them. In urgent cases the artillery brigades will have to go straight into their fighting positions, the brigade commanders galloping ahead to reconnoitre.

A division does not necessarily deploy in the form of a T, nor do all the units march up to the head of the column before turning outwards. Usually the artillery brigades will branch off right and left from the column of march and proceed diagonally to their positions. Each officer sent back to guide a brigade should halt at the turning assigned to it, and pick up the brigade as it comes along.

The Advance into Action.

The brigade being assembled in the preparatory position, also called the "position of readiness," the brigade commander with his staff gallops forward to reconnoitre the firing position. Unless this is close at hand, the brigade follows him at a walk or trot, with all three battery commanders and their staffs in front. Having selected the position (see *Artillery Positions*), the brigade commander sends back his orderly officer to meet the battery commanders and send them on to him; the orderly officer then guides

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the batteries to the position. In the meantime the adjutant is laying out brigade telephone lines and establishing communication with the C.R.A. The battery commanders meet the brigade commander, reconnoitre their battery positions, and, if the position is a concealed one, their observing positions, and each sends back the section commander who has accompanied him to bring on the battery. By the time the guns are unlimbered the target has been reconnoitred, the range taken, and everything is ready to open fire.

The above procedure is subject to considerable variation. In encounter or pursuit the brigade may have to trot straight from the column of march into position, with no more time for reconnaissance than that gained by the brigade and battery commanders in galloping ahead. In attacking a prepared position, in defence, and in retreat the position will be fully reconnoitred beforehand, and all preparations completed before it is occupied.

Changes of position are carried out as quickly as possible in order not to interrupt the fire for longer than can be helped. It will usually be possible to send officers to reconnoitre the new position before leaving the old one.

The advance into action of a single battery is carried out in the same manner as with a brigade. The advance in open country is illustrated in Fig. 111; but although this formation is always adhered to in principle, the ground will rarely be open enough to admit of an advance in line, and in most cases the advance will be in column of route.

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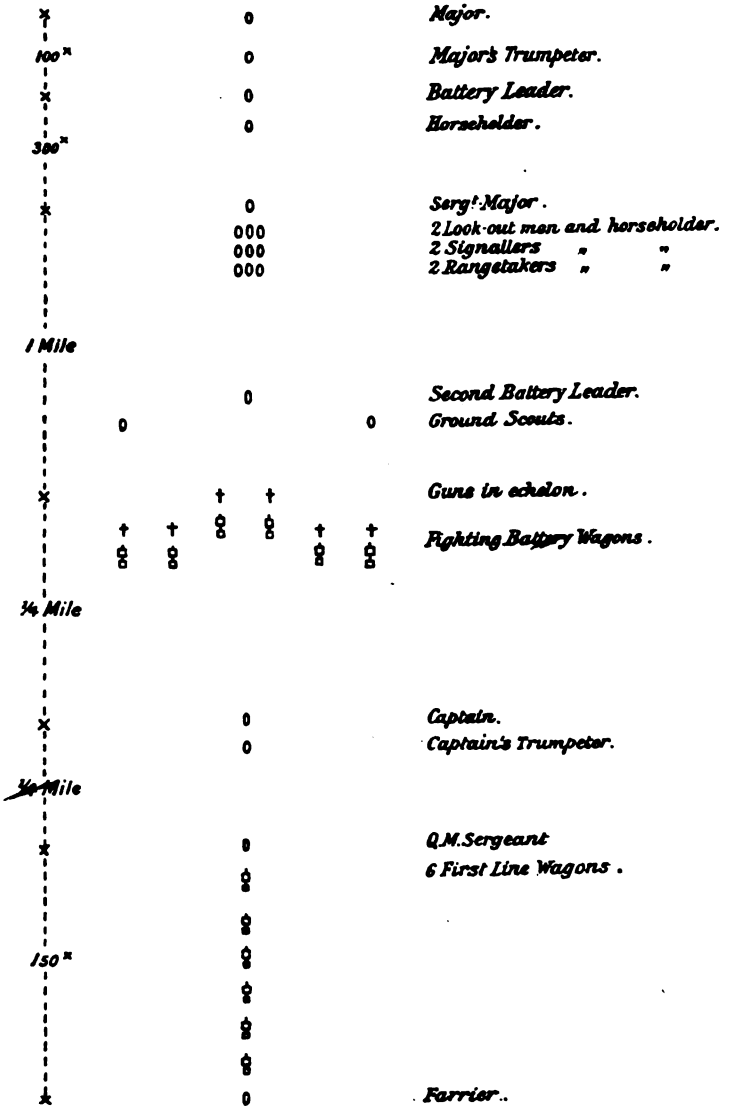

Battery advancing into action.

FIG. 111.

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The battery is preceded at a distance of about 300 yards by one or two mounted **ground scouts**, who look out for difficult ground. If no ground scouts are available, the Nos. 1 must gallop out without orders on approaching difficult ground, and guide their lead drivers by signal to the best crossing places.

When approaching a position, especially a concealed position, it is important to avoid raising dust, even if this entails advancing at a walk. If a sky-line has to be crossed within view of the enemy, the best method is, if possible, to form the battery in line behind it and cross at a trot.

Coming into Action.

In the open position the battery commander marks for the centre of the battery, with his sergeant-major 50 yards behind him. The battery leader leads the battery on to the position, and the guns are unlimbered by order of the battery commander. The wagons, on approaching the position, drop back 40 yards, and come up and unhook on the left of the guns as soon as the gun limbers are clear. The captain, on seeing the battery commander marking the position, gallops forward to him and receives instructions as to the general position of the ~~wagon line~~, and information as to the enemy. He then selects a position for the wagon line, leads the limbers and wagon teams to it, signals to the first-line wagons to join them, and returns to the battery.

In the concealed position, the battery commander, having reconnoitred the position for his guns, sends

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the section commander who accompanies him to lead them to this position, while he himself proceeds to the observing position and makes his preparations for opening fire (see *Laying*). The battery leader then brings the battery into action as in the open.

The above is the ordinary method. When the ground is difficult it saves time to halt the battery about 100 yards short of the position and to fall out the section commanders, and if necessary the Nos. 1 and layers, to select and mark emplacements for the guns. With a heavy battery it may be necessary to halt it while the detachments level the emplacements with pick and shovel, and improve the approaches.

The occupation of a position by day and night is further considered under *Artillery Positions*.

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CHAPTER XIX.

ARTILLERY POSITIONS.

General.

It is a common criticism by foreign officers attending our manœuvres that we "pick out the eyes of the country" for artillery positions. We turn out small forces for manœuvres, rarely exceeding two divisions on each side, and, according to Continental standards, we work on too wide a front in proportion to the strength of the force. Moreover, much of our divisional training is done upon open ground such as Aldershot or Salisbury Plain, which an attacking force would carefully avoid in war.

Our system has this advantage, that if troops are trained to work on a wide front they will find it easy to work on a narrow one. However, one result is that we are apt to form false ideas as to the nature of a real artillery position on active service. The ideal is a commanding crest, affording a perfect view of the battlefield, from which an artillery brigade can do target practice at the enemy's troops up to 6000 yards. But on the large scale, when each division of 12 battalions and 76 guns has to fight on a front

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of two miles or less,[1] it will never be possible to find four commanding positions for the four artillery brigades, besides a position for the heavy guns. The batteries will have to come into action where they can, in cornfields or meadows, in villa gardens with the palings broken down, on railway embankments, in single or double tiers of fire. There are only two essentials about an artillery position; one is that the guns can reach the enemy, the other is that they can be layed upon him, either directly or indirectly. There is absolutely no excuse for artillery remaining idle in face of the enemy; if they cannot see him, they must push forward until they do, even if this entails their being used as machine guns.

Qualities of a Good Position.

Even in the most difficult country for artillery there will be a certain amount of choice, if only between bad positions and worse. The points determining the selection may be classed in the following order:

1. Within effective range of every prospective target.
2. Good view of every prospective target.
3. Concealed approaches.
4. Concealment for guns.
5. Concealment and, if possible, cover for horses.
6. Difficult to range upon.
7. Easy to entrench.
8. On the defensive, no dead ground in front.

[1] This allows for one infantry brigade in reserve. See F.S. Regulations 1909, Part I., page 114.

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"Sound platforms" used to be laid down as an essential point. But, as a matter of fact, the platform, whether hard or soft, makes little difference to the shooting of a Q.F. gun, though it certainly does make a difference to a howitzer.

Open versus Concealed Positions.

It may be laid down as a rule that when opposing troops come into contact—that is, within a quarter of a mile of each other—the artillery which intervenes in the combat must do so by direct laying, over the open sights. For the troops will not then be formed in two straight lines facing one another, but the line of battle will be broken and irregular, marked by a series of little independent rushes on one side, and corresponding local retirements on the other, and the whole still further confused by small local counter-attacks, flank attacks, and envelopments. Indirect laying from the concealed position is only suitable for directing the collective fire of a battery, and at close quarters the series of fights are each on too small a scale to be dealt with by the fire of a whole battery, even if the line and elevation could be changed quickly enough to follow up the fluctuations of the combat. At this stage of the fight, though the battery commander maintains the control and general direction of the fire, a great deal has to be left to the section commanders, who select the particular portions of the target at which their guns are to fire, and it may even be necessary to order "section control."

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It follows, then, that if the guns are to assist the infantry in a fight at close quarters, they must be in the open, where the layers can see the target. And if they have previously been in a concealed position, they must come out into the open at this stage of the combat.

It is sometimes held that the attack on an entrenched position is an exception to this rule; and so it is when the defender occupies a well-marked continuous line of defence. But in most cases the defender will not occupy a continuous enceinte, but will use short firing lines fitted to the irregularities of the ground, disposed in echelon and at angles such as to flank each other. Each of these will have to be taken by a local assault, possibly preceded by envelopment and followed by a counter attack, and the fight will be no less complicated than in the open country.

When the conditions are such that the collective fire of the battery can be directed on a well-defined target, the **concealed position** has many advantages over the position in the open. The greatest of these is the element of surprise; the enemy may suspect the presence of concealed guns, but he cannot tell where they are, nor in what force. And if he exposes himself they may suddenly open an overwhelming fire upon him, to which he can make no effective reply. A brigade of artillery in a concealed position may be looked upon as a **reserve of fire-power** which can be suddenly applied, and which, if judiciously held in reserve, may be of the greatest value to its side.

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This argument has lost something of its force in consequence of the successful results recently obtained by **aeroplanes** in reconnaissance. But even if the G.O.C. is informed of the approximate position and numbers of the enemy's concealed artillery, he will still be unable to prevent it from firing at him. For ranging at a battery in the "retired concealed position" (see below) is a waste of ammunition unless the fire can be observed from a balloon.

Another advantage of the concealed position is the power which it confers of **changing position** without the enemy's knowledge (barring the aeroplane) and without exposing the teams to fire.

The **protection** afforded by the concealed position is a secondary matter, since protection must always be considered subordinate to effect. But it may enable a small force of artillery to cope with a larger force, which is an important consideration as affecting our own small army.

In this connection it may be pointed out that, in the concealed position, the protection obtained is solely due to concealment from the enemy's view.

FIG. 112.

Since the angle of descent is always greater than the angle of elevation, if two guns be firing at each other from positions such that each gun can barely

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clear the crest, each will be able to hit the other. A howitzer might possibly obtain cover from fire by getting close behind a railway embankment, but a gun, if able to fire itself, must always be exposed both to gun and rifle fire.

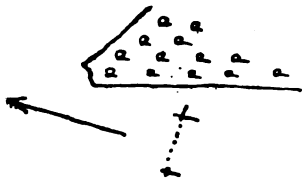

Fig. 113.

A special form of position is that in which **flank concealment** is available. Thus in Fig. 113 the battery is in the open as regards its target, while concealed from the position of the enemy's line directly opposite to it. This is especially suitable to long-range heavy guns.

Varieties of Open Position.

In Fig. 114, A is the fully-exposed position in the open, and is to be avoided when possible. B might

Fig. 114.

be called a concealed position, but it admits of direct laying through the hedge, and affords concealment till the guns open fire. C is the position at the foot of the forward slope, sometimes used by the Boers. The guns are difficult to detect, but the field of fire is limited. D is the forward slope position, used in defence when it is impossible either to see down the slope from the crest, or to flank the slope from a

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position to one side; it is always strongly entrenched. E is the forward crest position, below the sky-line; this is preferable to putting the guns on the extreme top of the crest. The guns are difficult to detect till they open fire; they are then easy to range upon. F is the rear crest position; the guns are on the sky-line, but are more difficult to range upon than in the forward crest position. The advantage is that they can be kept run back till they open fire.

FIG. 115.

Other things being equal, the best open position is that which gives the maximum of concealment and cover. Thus the open position on the bank of an Indian river shown in Fig. 115 is an excellent one. The approach from the river bed is perfectly concealed; the horses obtain cover from fire under the scarped bank, and the guns are well hidden by scrub jungle.

Varieties of the Concealed Position.

In Fig. 116, G is the semi-concealed position, such that the layer, by standing on the trail, can see to lay for line, while elevation is given by clinometer. This usually entails the exposure of the top of the wheels and shield. It is the favourite French position. H is the advanced concealed position, in which the line can be given by the section commander on his horse,

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or standing on a wagon behind the gun. The guns are completely concealed, but the flashes are visible. It requires 10 feet of cover above the muzzle of a field gun to conceal the flash, or 20 feet for a field howitzer firing full charge. I is the ordinary fully-

FIG. 116.

concealed position. J is the retired concealed position; the disadvantage is the extra distance from the observing station, and, sometimes, the necessity for digging in the trail to get sufficient elevation. On the other hand, this is the safest of all positions, since ranging at it will be pure guesswork if more than 500 yards behind the crest.

Besides positions in which concealment is afforded by the shape of the ground, there is an immense variety of positions in which the guns are screened from view by woods, hedges, high crops, villages, and other natural or artificial features. Thus on the Yalu the Japanese occupied a position on an island in the river bed by night, and constructed wooden screens, artistically covered with vines, for their howitzers.

An important feature of a concealed position is the possibility of running the guns up to the crest, or into the open, whether in order to repel an assault or to employ direct laying at a critical stage of the

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combat. For this reason the concealment afforded by an undulation of the ground is in most cases preferable to that obtainable behind a wood or similar natural feature.

One objection to all concealed positions is the **dead ground** in front of them.

Thus in Fig. 117, so far as the trajectory is concerned, there is 1000 yards of dead ground in front of the crest at the lowest elevation at which the

FIG. 117.

gun can be fired. But by bursting the shrapnel just clear of the crest, the angle of opening, combined with the droop of the bullet-cone, will enable this ground to be searched sufficiently well for practical purposes. This method is, of course, inapplicable when the ridge is held by our own troops in a defensive position.

Occupation of a Position.

In taking up an **open position**, the simple method of "halt, action front," will not always be applicable. When under fire it will be desirable, if possible, to unlimber the guns and unhook the wagons under cover, and to run both into position by hand.

The technical details of the occupation of a **concealed position** have already been given under *Manœuvre*. Regard must be had to the possible

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tactical necessity for running the guns into the open, or up to the crest; and if this is likely to be necessary all preparations must be made, such as smoothing tracks for the guns, and having additional drag ropes ready to haul them up.

The occupation of a position by night requires careful preparation. The point at which the guns turn off the road must be marked by a mounted man posted there. Thenceforward the track must be clearly marked. A rope may be laid as a guide, or a thick trail of torn paper, or a trail of white-wash from buckets. The emplacement for each gun may be marked by a newspaper weighted with stones, or other conspicuous mark. The following may be taken as an example of ordinary procedure:

1. Single dismounted officers reconnoitre the approaches and positions by daylight; if possible, ranges are taken and preparations made to open fire.

2. Soon after sunset, small dismounted parties lay the guiding marks.

3. When dark enough, batteries move off at half-hour intervals from the position of readiness. All guns leading, followed by the six first-line wagons; detachments rear; no lights or smoking, silence observed, everything liable to rattle tied up.

4. Section commanders lead their guns into position. Guns are unlimbered and the limbers

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halt till the wagons have come up; limbers and teams then file off together.

5. As few horses as possible are taken into a position occupied at night. All riding horses are left behind, and, if the ground permits, the lead and centre horses of the teams are taken out.

6. If the position is to be entrenched, the detachments carry the entrenching tools and work is commenced as soon as the guns are in position. In this case the ammunition is taken from the wagons and limbers, and these go to the rear together.

For night entrenching, it is advisable to carry empty sandbags, or corn-sacks and similar substitutes. It is much easier to fill sandbags and pile them up than to revet a parapet in the dark.

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PART IV.

COMBINED TACTICS.

CHAPTER XX.

MODERN Q.F. TACTICS.

At the beginning of this century it was held that guns must not venture within rifle range of the enemy, except on extreme emergency. And this view was confirmed by the disaster to Long's brigade at Colenso, when the whole of the men were shot down by the Boers at ranges of from 1000 to 1200 yards, and the guns were captured because no one was left to work them. At the present day the conditions are very different. The shielded gun, with the shielded wagon beside it, constitute an armoured emplacement in which the gunner is comparatively safe from infantry fire down to a range of 500 yards. It is not desirable to venture within such a short range of the infantry if the target can be seen from a longer range, because the gun is almost as efficient at 3000 yards as at 500. But whenever increased fire-power can be gained by pushing forward, and when it is possible to do so without heavy loss during the advance, the guns must be handled with the utmost

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boldness, taking full advantage of the protection of the shield.

After the advent of the Q.F. gun, and before the introduction of the shield, the **concealed position** was in high favour. It was considered that it afforded practically complete protection, both from gun and rifle fire, without loss of efficiency. But it was soon realized that when the opposing troops come into contact, and the combat assumes a complicated form, mechanical fire direction cannot replace direct vision over the sights. Moreover the dangers of the open position have been reduced by the shield, which affords good protection against the shrapnel fire of guns, though not of howitzers. Accordingly it is now held that the concealed position is to be preferred for engaging fixed targets such as guns or lines of trenches, but that to intervene in a combat at close quarters, as in supporting or repelling an attack, the batteries must come out into the open. And where both sides are on the move, and the engagement promises to culminate in a direct encounter, the batteries cannot afford to lose the time required to shift from the concealed to the open position, but must come into action in the open at the outset.

The enormously increased **rate of fire** afforded by the Q.F. gun has been utilized in several ways. In the old days, when a battery took ten minutes to range, and fired two rounds a minute, artillery fire was a deliberate affair, and not much effect was expected under half an hour's firing. A Q.F. battery engaging an easy target expects to get its range in

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one minute, and is then able to fire 60 rounds a minute, or 100 rounds in one minute after the fuzes have been set. If the batteries are kept silent, and if the enemy can be induced to expose his troops in the open, he can be suddenly overwhelmed with a storm of fire before his men can get under cover.

The increased rate of fire has afforded the means of increasing the **target front** covered by a battery. If 20 rounds a minute is sufficient for a target 100 yards wide, then a battery firing 60 rounds a minute can cover 300 yards of target front by sweeping, provided that the range and fuze to every part of the target have been determined.[1]

In the B.L. days, if a fresh target appeared a battery had to be taken off its old target to engage it. With a Q.F. battery, one section is left to continue the fire at the old target, sweeping and trebling its rate of fire, while the remainder engage the new target.

The proper **tactical rate of fire** is a matter which does not directly depend on the rate of fire of the gun, but rather on the vulnerability of the target. Thus it might be hastily assumed that because an enemy has been located in a certain spot, therefore the battery should fire, and continue to fire, at its highest rate in order to destroy him. The practical result would be that the enemy would lie low till the storm was over and the ammunition exhausted, and would then renew the combat. In most cases artillery fire is not so much destructive as **neutralizing.**

[1] The French allot 200 metres of target front to a four-gun battery.

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That is, the object is to prevent the enemy from exposing himself in order to fire, and from shifting his position. Therefore a steady rate of fire is kept up, increasing if the enemy is still observed to be firing, and decreasing if he remains silent; while if any movement can be observed, it is checked by a burst of rapid fire. It is impossible to lay down any fixed rate; but at a very rough estimate it may be said that, when the troops are not closely engaged, a rate of fire of 10 rounds a minute is sufficient to keep down the fire of a line of infantry 100 yards long behind a bank or in a trench. This estimate is arrived at as follows; Taking the effective spread of the shrapnel bullets at 20 yards, each rifleman will be liable to be shot twice a minute if he puts his head up to fire. After each shrapnel bursts over him, he will have only 30 seconds to make up his mind, to get up, pick up his target and fire. If the rate of artillery fire were absolutely regular, the rifleman would soon get accustomed to firing between shrapnel-bursts. But if, while maintaining the average steady rate, the rate per minute and the distribution be judiciously varied, the rifleman will never know when a shell is coming, and will be nervous about getting up to fire.

In the B.L. days, the question **whether artillery should fire at infantry or at guns** was much discussed. The modern solution is to fire at both; or, in case this is impracticable, to fire at whichever is most dangerous to our own infantry.

Massing the fire of dispersed batteries has now become a fine art, and in a deliberate action, when

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fire-commander's panorama sketches (see *Reconnaissance*) have been prepared, and telephonic communication established, the C.R.A. can bring an enormous volume of fire to bear upon any desired point. This system has, however, its practical limitations, and is by no means an universal panacea for success. Thus if the line of battle advances one mile, fresh communications will have to be established, and fresh sketches made. The C.R.A. is not likely to find a station from which he can observe the whole front of the battle, and if he shifts his station he will require a fresh set of lettered sketches. When twelve batteries are turned on to the same point, they must either take it in turn to range, which will take half an hour, or else the C.R.A. must be content with a somewhat vague and ill-directed fire, spread over an area, say, a quarter of a mile square. The French were originally the great exponents of this, the scientific method of fire, and French writers advocated its employment on all occasions, suitable or otherwise. This has led to something of a reaction, and senior French officers are now inclined to speak somewhat contemptuously of the C.R.A. sitting in a control station and juggling with his trajectories. The method is an ideal one, and, under suitable conditions, is capable of giving brilliant results. But such conditions are rather the exception than the rule, especially in a battle of encounter. And if it were attempted to introduce complete centralization of fire-direction as the normal method, this would have a prejudicial effect upon the

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initiative of the artillery brigade commanders, and the divisional artillery would become a slow, inactive force, incapable of doing anything without an order, and unfit for that close co-operation with the infantry which is the object of its existence.

Registered Areas.

The target front allotted to an artillery brigade does not usually exceed half a mile, yet in this frontage there may be several places where an enemy may possibly appear. If it be possible to range and find fuze on these points beforehand, the enemy, when he appears, can instantly be overwhelmed with fire. It is, therefore, frequently desirable to expend a few rounds in ranging on likely points. On the defensive, when there are several ridges in front which the advancing enemy must cross, this precaution should always be taken, provided that this can be done without giving away the position. In the attack, any defile from which a counter-attack, if delivered, is likely to emerge, should be ranged upon beforehand.

Close Artillery Support.

With the introduction of the Q.F. shielded gun, the French brought in the system of pushing forward single batteries or sections to short ranges in close support of the infantry, whether in attack or defence. This system has now been generally adopted. It will be further discussed in Chapter XXIII.

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Night Attacks.

The increased power of the Q.F. gun has done much to encourage night operations. The modern reply to this is the searchlight, which enables the artillery to fire at night. This subject will be considered in Chapter XXVI.

SPECIAL TACTICS OF VARIOUS NATURES OF Q.F. ARTILLERY.

Field guns have no special tactics. The field gun is the maid-of-all work of the army, liable to be called upon to breach a parapet or to gallop with the cavalry, though it is not well adapted to either purpose. Its qualities are developed principally with a view to engaging infantry in the open. Its shrapnel fire is effective up to 6000 yards, and its maximum rate of fire is 20 rounds per minute.

Field howitzers are specially designed for high-angle shrapnel fire at shielded guns, and for breaching overhead cover with high-explosive shell. They are also capable of engaging infantry with direct shrapnel fire, and up to medium ranges they make powerful though slow-firing field guns. The field howitzer can fire out of almost any concealed position, such as a railway cutting or a hollow road, where a field gun would be useless, and can fire in any formation, even in column of route. It is effective upon troops in deep trenches or behind parapets. It is capable of hitting a captive balloon, but is too slow for a

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dirigible or an aeroplane. The range is about 7000 yards, and the rate of fire does not exceed five rounds a minute.

Horse Artillery are employed in the cavalry reconnaissance and in the cavalry combat, and in the pursuit. They are also capable of being used as ordinary field guns. Their mobility renders them most valuable when guns have to be quickly transferred from one part of the battlefield to another, when reinforcements are required at a point say 20 miles distant, and when a position seized by the cavalry has to be quickly occupied. They are also well suited for use in the preliminary stages of the defence of a position. The maximum rate of fire is from 20 to 25 rounds a minute.

Mountain Artillery are field guns made light enough for pack transport. Besides their proper duties in mountain warfare, their portability makes them very useful in the field. Thus a mountain gun can be taken up to the flat roof of a house, or fired from a railway truck. Also mountain artillery, by filing along ditches or narrow paths in woods, can often accompany infantry in close support where wheeled artillery could not follow.

Heavy Field Artillery includes heavy field guns, and, in foreign armies, heavy field howitzers. Its special quality is its long range, which, with our own gun, is over 10,000 yards. This enables the heavy artillery, from a central position, to fire on any part of the battlefield. It would be a mistake to suppose that a heavy battery, because of its long range,

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should be kept at a long distance from the enemy. On the contrary, the ideal method of employing heavy artillery is to push it forward to a concealed position close to the enemy's line, whence it can enfilade his batteries and trenches on either flank.

FIG. 118.

Heavy artillery can also be employed for shelling the enemy's camps or billets behind his outpost line; for long-range fire at railway stations, bridges, etc.; for destroying field entrenchments; and, on the flanks, for dealing with turning movements of the enemy, and obliging him to go very wide to escape their fire.

MODERN FRENCH ARTILLERY TACTICS.

In the French method of employing artillery the national habit of centralization and systematization is carried to a degree which would paralyze troops accustomed to let their leaders do the thinking, as in the Russian and German armies. The French officer requires the bridle, not the spur, and the regulations are intended to curb and direct his energy. He can be trusted to disregard restrictive regulations when vigorous action is required.

The French begin by dividing the battlefield into sections, to each of which a certain force of infantry and artillery (not necessarily equal forces) is allotted.

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The artillery of each section is divided into two classes, namely *infantry batteries* to support and accompany the infantry, and *counter batteries* to engage the enemy's artillery and so protect the infantry from its fire. At the beginning of the combat the whole of the batteries are in reserve in positions of observation (in action) or of readiness (limbered up).

The infantry batteries constitute about one-third of the whole artillery force. They are each "in immediate association with an attacking infantry unit." Each infantry battery fires on the objective of its infantry unit, neglecting any artillery fire directed at itself. It accompanies the unit "rather with its fire than with its guns," but it must not shrink from pushing forward to the closest ranges, relying on its shields, if this is necessary to make its fire effective.

This method, which has recently been introduced, supersedes the former French system of detailing a small number of *batteries de combat* to advance in close support of the firing line. The number of batteries accompanying the infantry is now more than doubled, and each of these may have to become a *batterie de combat*, and advance right up to the firing line, if occasion arises.

When the section in which the decisive attack is to be made has been selected, the artillery of that section is reinforced, leaving only counter batteries in the other sections.

The counter batteries are all kept out of sight till required. If an enemy's battery opens on the

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infantry, or on one of the batteries accompanying them, it is immediately "neutralized" by bringing a counter battery into action against it, usually from the semi-covered position. If a second hostile battery opens on the counter battery, a second counter battery "neutralizes" it, and so on.

Since the opposition to the advancing infantry will not only be from the guns in the section of the attack, but from those in all the other sections, or at least the adjoining sections, the counter batteries in all sections will find themselves employed. Any which can be spared will be used to reinforce the section of the attack. The French no longer advocate massing the fire of dispersed batteries, but prefer to mass the batteries themselves.

In the **defence**, the infantry batteries are handed over to the infantry commanders of sections, while the counter batteries, all at first kept in reserve, are usually directly under the G.O.C. (Presumably they are under the immediate command of the C.R.A.) They may, however, be allotted to sections as in the attack. The infantry batteries accompany the infantry units disposed in advance of the position, and retire slowly on the position, delaying the attack as much as possible. When driven back to the position where a stand is to be made, they are posted as close as possible to their infantry units.

Unlike the Germans, the French do not propose to run the whole of the defending artillery up to the crest to repel the decisive infantry attack. It is held that for close defence at ranges of 500 metres or so

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the infantry must rely principally on their rifles and machine guns. A relatively small number of field guns are to be run up to the crest by hand to assist in repelling the attack.

Criticism of French Methods.

So far as relates to the infantry batteries, the French ideas seem incontrovertible. The weak point is the fire-effect of the counter batteries. It is gratuitously assumed that if a hostile battery opens on the infantry, a counter battery will suffice to "neutralize" it. A good battery will refuse to be neutralized; and if it has a favourable infantry target, it will at most turn a section on the battery which attacks it. It is shown in Chapter XXI. that the fire-effect of a gun battery engaging artillery is principally due to direct hits. If the hostile battery be completely concealed, it will take a long time, and an enormous amount of ammunition, to disable it. Even if it be fully exposed, it will probably not be completely silenced under half an hour's shooting, at medium range. And in the meantime the advancing infantry are likely to suffer, and will probably ask their own infantry batteries to turn on to the hostile batteries to relieve them. This will upset the whole organization of infantry and artillery batteries. It would appear far preferable to adopt the German method of getting the whole of the artillery into position as soon as possible, and smothering any hostile battery or brigade which attacks the infantry with concentrated fire.

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As has been said, the French rate the effect of their counter batteries higher than we should do. This is partly because the French expect to work at much shorter ranges than those on which our methods are based.[1] Thus in the artillery manœuvres of Lorlanges, 1910, which were carefully arranged as a typical illustration of modern French tactics, the greatest range fired at did not exceed 2500 metres. This cannot be due to the nature of the country, since the French landscape is, on the average, more open than our own. Possibly the divergence of opinion is due to the fact that our own artillery ranges are all on open waste land, which is not a Service condition, and that our only recent experience of the employment of artillery in war has been in firing over the open veldt.

This idea of the artillery as a weapon to be employed principally at decisive ranges influences the whole French system of tactics and fire-discipline (see Chapter X.). The French disapprove of massing fire by telephone; this is because at short range the individual fire of batteries is more effective. They object to the use of the retired concealed position, with the ranging officer at a distance from his battery, as being too slow for employment at decisive range. Their methods of fire-discipline are rough and ready, suitable for use in the semi-covered position under heavy fire; our own more elaborate methods, like the German methods, are

[1] This has been pointed out by Major Budworth, R.H.A., in an able article in the *Journal* of the R.A., Vol. XXVII.

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such as to give excellent results in the peaceful seclusion of a concealed position at 4000 yards, but are not so reliable in the open.

Taking a broad view of the matter, it would seem that each nation has based its tactics and fire-discipline on a pre-conceived idea of war. Now war never turns out exactly as we expect it, and the most intelligent and adaptable artillery enjoys a great advantage over that which is only accustomed to work in one way, and is tied down by hard-and-fast rules of procedure. The French artillery and our own have much to learn from each other, and we, with the opportunities for training afforded by the longer service of our men, could well afford to embody their methods in our system, in order to render it more complete and more elastic, in case the conditions under which we have to fight are not exactly in accordance with our expectations.

GERMAN ARTILLERY TACTICS.

Within the last few years the Germans have introduced the system of breaking up artillery into groups of three or six batteries distributed along the front. The system is similar to our own, but on a larger scale. The Germans speak of *Abteilungen* (of three batteries) where we should speak of batteries. They never succumbed to the heresy which prevailed at the beginning of the century as to the employment of fire from the concealed position as the normal method. They rightly consider the

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concealed position unsuited to the support of infantry in the decisive stages of the combat, and lay down that:

"At the decisive stages of the combat the artillery will almost always have to renounce the advantages of the concealed position and to come into action in the semi-concealed position or in the open."

The principle that the distribution of the infantry must be subordinated to the choice of artillery positions is clearly laid down:

"368. The artillery constitutes the structural framework of the combat. The distribution of the remainder of the troops depends, as a rule, on the positions assigned to the artillery. The General, after reconnoitring the field of battle, selects the artillery positions: in this he is assisted by the officer commanding the artillery. The General determines the force of artillery to be brought into action, and decides when and how it is to open fire."

The German divisional general gives his own orders as to the employment of the artillery, and until battle is joined the C.R.A. is merely his technical adviser. But thenceforward the C.R.A. becomes the artillery fire-commander:

"426. The larger the force of artillery the more important it is that complete control of its fire should be in the hands of the artillery commander. . . . The ideal is that the full fire-power of every battery is used to the best advantage."

In the attack, the object is to bring an enveloping fire to bear on the point of assault: "if there are any

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guns in reserve, they must now be brought into action." Artillery fire upon the batteries must be disregarded at this stage.

"Single batteries must be sent forward to accompany the infantry attack up to close quarters."

In attacking an entrenched or prepared position, the German method is to approach by night and assault by day.

In the defence, the general idea is that the position is held by a line of sentries, and is not manned till the direction of the attack is disclosed. The artillery, if overpowered, are withdrawn under cover; but "every gun must open fire to repel the infantry attack."

In the pursuit, the object is not so much to follow the enemy as to outstrip him and to bring flanking artillery fire to bear on his columns.

The German artillery regulations are so much to the point that the author is tempted to indulge in more extensive quotations. But such quotations can only give an imperfect idea of the German methods, and officers interested in the matter are recommended to study the original or the translation published by the General Staff.[1]

[1] *Drill Regulations for the Field Artillery of the German Army.* Harrison & Sons, St. Martin's Lane.

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CHAPTER XXI.

ARTILLERY TACTICS AGAINST THE VARIOUS ARMS.

Artillery versus Artillery.

The gun-shield offers fairly complete protection against frontal time shrapnel fire from field guns to the men behind it. Yet if the battery be smothered with repeated bursts of shrapnel fire its efficiency will be considerably reduced. A certain number of men will be hit by bullets passing under the shields, through the sighting apertures, and between the gun and the wagon. Sights and fittings in front of the shields will be struck by bullets; movement between the guns will be dangerous, and change of position (except by man-handling) and replenishment of ammunition will be impossible. Still, the only means of disabling or even silencing the guns will be to make direct hits upon them. Therefore, in engaging a hostile battery with field guns, the endeavour is to get direct hits, while at the same time keeping up a shower of shrapnel bullets. The range and line are very carefully corrected, gun for gun, and the fuze is lengthened so as to give about 75 per cent. of bursts on graze.

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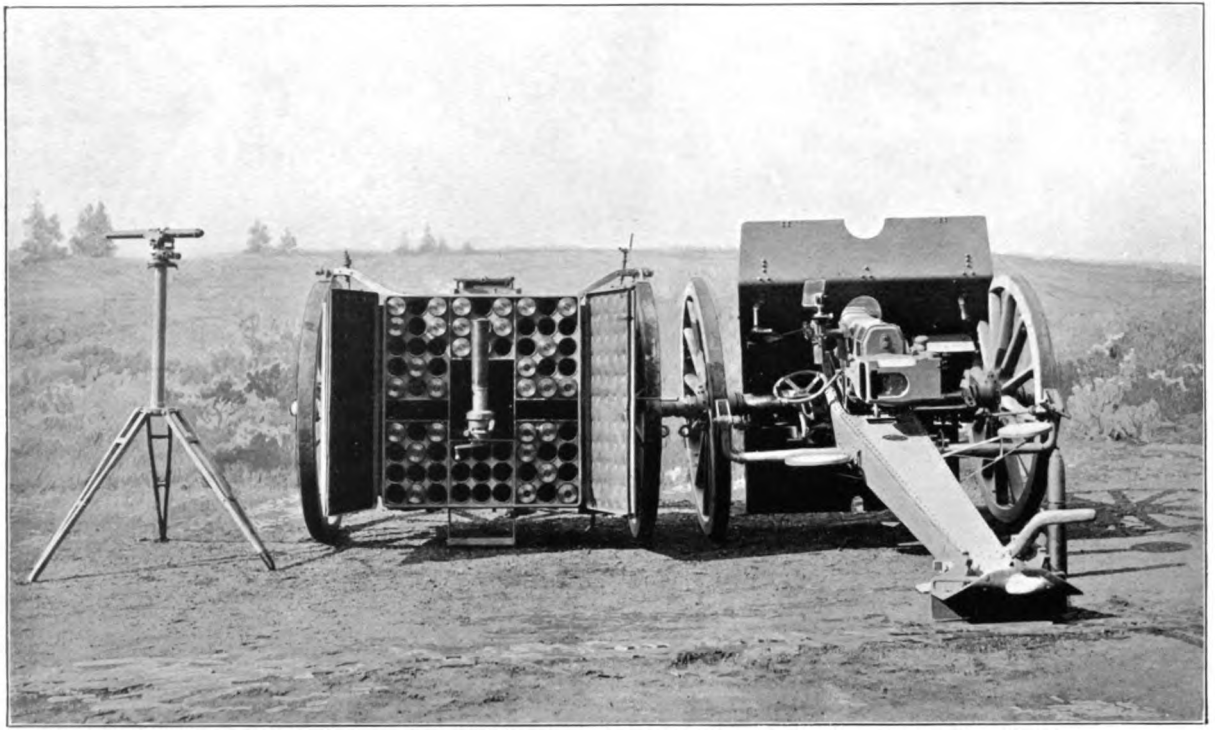

PLATE XIII.—ARMSTRONG 14·3 PR. FIELD EQUIPMENT WITH COMPRESSED AIR RUN-UP, 1910.

To face p. 296.

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Whenever it is possible to bring oblique fire, enfilade fire, or cross fire to bear upon the enemy's artillery, this should be done.

The 18 pr., under practice camp conditions, makes one hit in four rounds on a fully-exposed gun at medium range; under service conditions it may make one hit in 10, or less. The French reckon 20 rounds to disable a gun at 2000 metres. At a very

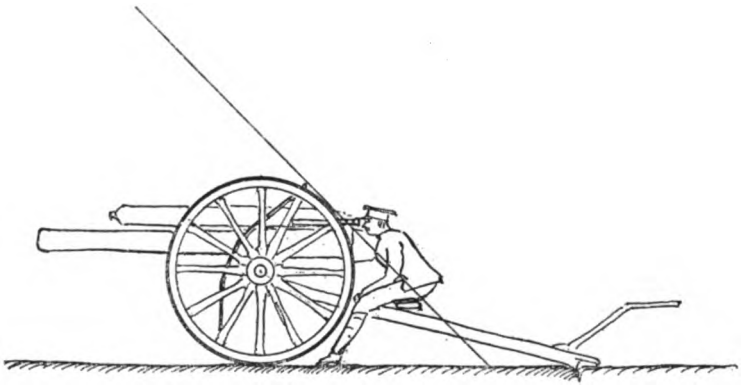

Fig. 119.

rough estimate, 100 rounds and half an hour may be allowed for the destruction of a hostile battery in the open between 3000 and 3500 yards.

When shielded guns are fired at by **field howitzers** the conditions are different. The graduated howitzer charges give angles of descent from 30° to 45°. Taking 35° as the average angle of descent, and adding 10° for the semi-angle of opening of the shrapnel, we get an angle of descent of 45° for the lowest bullets. It will be seen from Fig. 119 that with the 18 pr. shield bullets descending at this angle

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will kill every man of the detachment, while with a high curved shield such as that of the Swiss artillery only the two men immediately behind the gun-shield would escape. The field howitzer is therefore much better adapted for producing immediate effect upon shielded artillery than the field gun, and after four or five minutes under howitzer shrapnel fire the detachments will begin to suffer heavily.

As regards making **direct hits**, even an exceptionally accurate field howitzer, such as our own new weapon, will not make the same proportion of hits as the 18 pr. at medium ranges, although it maintains its accuracy better than the field gun at ranges over 5000 yards. However, a direct hit from a howitzer high-explosive shell will certainly disable the gun and the whole of the detachment, and probably the wagon as well; also there is some prospect of splinter effect from shells bursting close to the gun.

It must be remembered that killing the detachments will not permanently silence good artillery, since the casualties will be replaced by men from the wagon line and ammunition column, down to the last driver. Other troops may be demoralized after suffering 25 per cent. of casualties, but there is no record of a gunner running away from his gun. This is not because the gunner is braver than the infantryman; it is because of the moral support afforded by the presence of the gun. The gun does not run away, and the gunner feels safer behind it than anywhere else.

The best procedure for howitzers in attacking shielded artillery is therefore to open with time

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shrapnel until the enemy's fire slackens, and then to proceed to lyddite with the object of destroying the guns. If the enemy re-opens fire, shrapnel must again be used until he is silenced, and the destruction of the guns can then be proceeded with.

When the conditions are such as to render accurate ranging difficult, howitzers are far more effective against shielded artillery than guns, since the latter depend principally for effect upon direct hits, while the effect of howitzer shrapnel fire is less dependent upon minute accuracy.

In firing at artillery, whether with guns or howitzers, there is nothing to be gained by coming out into the open. "Pin-point" shooting is the desideratum, and this can be conducted more accurately from the concealed than from the open position. Precise shooting must be conducted deliberately, the line and elevation of each gun being corrected at first after each round, and later after each group of three rounds from the same gun, and with good means of communication these corrections can be given to guns in the concealed position without loss of time. The most important matter is to have a good view of the target, and if this cannot be obtained from the position, every effort should be made to push forward guns, if only single sections, to concealed positions with observing stations from which the target will be plainly visible. For the accurate individual fire of a small number of guns is likely to be more effective against shielded artillery than the less accurate collective fire of several batteries.

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When a brigade is turned on to a single hostile battery, the target must be divided, each battery taking one section; and if the actual or probable post of the battery commander can be located, at least one section must be turned on to it.

When only the flashes of the enemy's guns are visible the procedure is the same, but considerably more time and ammunition will be required. When, from the map or general nature of the country, it is possible to estimate the steepness of the reverse slope, the knowledge that a field gun requires ten feet of cover above the muzzle to conceal the flash will give a clue to the distance of the guns behind the crest.

It is sometimes possible to locate from the map the probable position of the enemy's limbers and teams, and in this case it will usually be advisable to detail a section to search for them.

When the conditions are not such as to permit of accurate gun-for-gun ranging, massing the fire of dispersed batteries upon each hostile battery in turn is likely to be more effective than letting each battery fire at the one opposite to it.

When information is received (as from an aeroplane) that hostile artillery is behind a certain crest, then if nothing is visible, and the information is not such as to locate the artillery within, say, 300 yards, firing at it will be little better than guesswork. Searching, combined if possible with cross fire, is the only resource, unless a balloon or kite is available for observation. The crest must be carefully examined

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with good telescopes to locate the enemy's observing stations, and any likely points fired upon.

Artillery versus Infantry.

The tactics of artillery as opposed to infantry have been modified by the increased rate of fire and by the power of firing from the concealed position, but the introduction of the gun-shield has made but little difference. Certainly it is possible to fire from a position much nearer to the hostile infantry than was formerly the case, but very little is gained thereby in fire-effect. The only real progress made is in the power of suddenly delivering a great volume of fire by surprise from a position hitherto unsuspected; and after a few unpleasant checks of this kind, infantry will be very cautious about exposing themselves in large bodies in the open, and will avoid presenting anything in the nature of a well-defined target. At manœuvres, it is a common sight to see a company in line at one yard intervals, lying down in a stubble field; on service, if such a target were exposed for two minutes to artillery fire it would be wiped out of existence. The infantry are taught that they have to build up their firing lines until they attain superiority of fire over the defence. If this be misconstrued to mean the formation of thick firing lines in the open under artillery fire, it will mean extermination to any infantry foolish enough to attempt it. For, as has been shown, it is extremely difficult to permanently silence shielded artillery; and though they may be "left for dead," and their presence forgotten by the

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infantry, they are liable at any moment to revive and deliver a storm of fire. In the South African War, when our opponents had practically no artillery, we found it necessary to advance in extremely thin lines in order to enable each man to get a little bit of cover for himself. If our troops had been exposed to the fire of modern guns, they would have found it altogether impossible to advance over the open veldt by daylight. A battalion of infantry, at critical moments, can deliver 15,000 bullets in one minute; a battery of artillery can deliver 36,000, and at anything over 1500 yards the percentage of effective shrapnel bullets is likely to be greater than the percentage of effective rifle bullets. The result, in future, will be a very marked preference on the part of the infantry, when fighting by daylight, for close country. Open pasture land in view of the enemy will be carefully avoided; if it has to be crossed this will be done gradually, a few men at a time creeping along the hedgerows to the next bit of cover. The fact of the ground being covered with crops at one season will certainly be taken into consideration in determining the moment of the declaration of war. The lines of advance chosen by the infantry will be through close and intersected country. Thus a road bordered by villas and gardens, leading into the enemy's position, will offer a safer line of advance by daylight than open fields.

One important result of the increased fire-power afforded by the Q. F. gun will be to encourage **attacks by night**, when the guns, unless assisted by

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searchlights, are ineffective. This question will be considered in a separate chapter.

As regards the **offensive action of infantry against artillery**, very little can be accomplished at shielded guns by collective fire at long and medium ranges. But if only a few of the infantry can get within 500 yards, the guns will make excellent targets. Some of the bullets will penetrate the shields; officers who expose themselves to observe will be shot down; sights and fittings will be struck; while the dozen or so of infantrymen, if separated and well concealed, will run little risk themselves.

When artillery attempt to bring up their horses, either to come into action or to limber up, within 1000, or even 1500, yards of infantry and in full view of them, the infantry should make the most of the opportunity. A battery limbering up presents a target 100 yards wide by 8 feet high, exposed for 1½ minutes, and in this time a well-trained company, firing at three elevations, ought to make 150 hits, if they lose no time in opening fire.

Artillery, unless provided with flank cover, are liable to suffer severely if exposed to enfilade fire. The detachments can protect themselves to a certain extent by running back their wagons so as to form a traverse on the exposed flank of each gun. But, even so, if a few marksmen can creep up on the flank of a battery they will make things very uncomfortable for the gunners. Failing an escort, the battery commander's only resource will be to send out the gunners from the wagon line, armed with rifles, to

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dislodge the infantry. Opportunities of getting on the flank of a battery will rarely occur; still there may be occasions when a small party of mounted infantry can make a dash for a point of vantage from which they can do a great deal of mischief before they are driven back.

Escorts.

Artillery in action can protect their own front; it is on the flanks that they require assistance, and this only against small parties. Thus a brigade in action, though well behind its own firing line, may be taken in flank by mounted infantry or dismounted cavalry who have executed a turning movement on the small scale. It is laid down that field artillery should if possible have a mounted escort, but this will rarely be available. However, field artillery on the battlefield will rarely move fast enough to distance an infantry escort. If no escort has been detailed, the artillery have always the right to demand an escort from the nearest infantry. Half a company for an artillery brigade will usually suffice.

Artillery versus Cavalry.

A century ago the cavalryman's ideal was a dashing charge straight at the front of the guns. The modern cavalry leader has more sense than to get in front of a gun-muzzle if he can help it. He will take his men round the flanks, get into the battery from the rear, and cut up the wagon line. And when he has got behind the battery he will dismount men to fire into

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it from the rear. Therefore the object of the gunner is to prevent the cavalry from getting round his flanks. In this the artillery are assisted by their escort, but the presence of an escort is no excuse for the gunners being caught napping. They must keep look-out men on their flanks, and be prepared to open rapid fire on any cavalry attempting to get past them.

The action of artillery against **dismounted cavalry** is the same as against infantry, except that the cavalry have a way of appearing suddenly in large numbers at unexpected places. When this occurs, the French method of rapid ranging followed by searching (*tir progressif*) is the best method of dealing with the cavalry, as the fire will probably be effective on their horses, which cannot be far behind them.

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CHAPTER XXII.

TACTICS OF HORSE AND MOUNTAIN ARTILLERY.

Horse Artillery in the Cavalry Reconnaissance.

The abstract theory of reconnaissance is as follows: Let A be an enemy in an unknown position. A line of mounted men, C1, is advanced across country

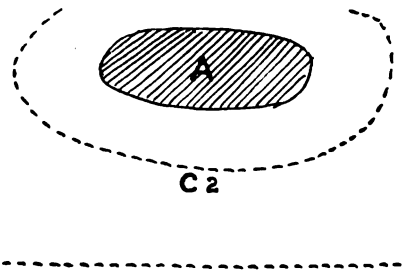

FIG. 120.

towards the enemy; where the line meets resistance it stops, where it meets none it advances, still keeping touch. Then finally the line will assume the form C2, enveloping and locating the enemy.

In practice, if the whole reconnoitring force were deployed in one thin line, a few riflemen behind hedges would suffice to stop it. Therefore the force

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is divided into formed bodies, advancing along parallel roads, each covering its front with patrols, so that if any slight resistance is met, a considerable force, up to one squadron dismounted, is quickly on the spot to deal with it. For overcoming more serious resistance, the reserve of the force, marching along a central road, is called up.

Now instances frequently occur where the enemy's parties are so posted that cavalry, mounted or dismounted, would have considerable difficulty in dislodging them. A house covering a main road or bridge and occupied by a dozen riflemen would be a serious obstacle to the advance. But if guns be available, a few rounds will make the house untenable. Hence a cavalry reconnaissance on the large scale is always accompanied by artillery. And since the artillery must be able to move quickly to any point where their services are needed, horse artillery are employed.

If the reconnaissance be opposed by hostile cavalry in force, then the horse artillery will act in support, whether the combat be mounted or dismounted.

When the enemy's position has been located, the horse artillery endeavours to draw the enemy's fire by firing on the position. Repeated attacks are made on various points in order to induce the enemy to open fire and disclose the situation of his guns. But if the enemy knows his business he will not reply to such fire, except with a few guns outside the main position.

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Horse Artillery in Cavalry Raids.

A favourite cavalry exploit is a raid on the enemy's communications. This requires fast marching, at a rate which field artillery could not keep up. When the long column of baggage wagons is sighted, the cavalry attack it. A mounted charge is useless; the column is on a road, usually between fences, and there are enough infantry with it to deal with any cavalry that can get among the wagons. Therefore the cavalry ride up to short rifle range, dismount, and pour magazine fire into the transport. This will kill a good many horses, but will lead to no decisive result, as the baggage guard will line the side of the road and return the fire. But when the horse artillery open fire on the transport, inextricable confusion will result, and the column will become a mass of plunging horses, drivers trying to escape, and overturned wagons. All organized resistance will quickly cease, and the cavalry can ride in and complete their capture.

If the cavalry get within reach of the enemy's ordnance park or divisional ammunition column, this may be guarded by infantry, but will be helpless under artillery fire.

Horse Artillery in the Cavalry Combat.

There are few places in Europe now-a-days where two cavalry brigades can ride at one another, sabre in hand. Shock tactics will in future be confined to the action of small bodies of cavalry. The tactics of the

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horse artillery consist in galloping out to one side of the ground, and pouring rapid fire into the enemy s ranks before the opposing lines meet. They are protected from the hostile cavalry by an escort. When firing on cavalry, they must disregard any artillery fire directed on themselves.

When large bodies of cavalry meet in ordinary close country, they will have to work dismounted. The dismounted cavalry combat differs materially from the infantry combat. Instead of the long lines of infantry slowly approaching one another, we shall have a more active form of warfare, the cavalry taking advantage of their mobility to make rapid flanking movements and to concentrate suddenly in superior force upon one point of the enemy's line. The cavalry ideal is that the enemy shall see nothing of them till he is shot or charged in flank. And to take part in this warfare the horse artillery must be no less active and alert than the cavalry.

Cavalry or mounted infantry are sometimes employed to seize a position before the enemy can reach it, and to hold it till the main body arrives. In this case the horse artillery commander will endeavour to give the enemy the impression that the position is held by artillery in force. He will fire rapidly and change position repeatedly. It does not matter if he exhausts all his ammunition if he can hold out till reinforcements come up.

The same applies to horse artillery holding a sham position in order to make the enemy deploy.

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Horse artillery are sometimes used as extra mobile field artillery, and are galloped across the battlefield to reinforce weak points.

Horse Artillery in the Pursuit.

There is little to be gained by following a retreating enemy and fighting rear-guard actions with him. The proper method is to get past his rear guard, overtake his retreating columns, and fire into their flanks. This will usually entail a long circuit by the cavalry and horse artillery, and the mobility of the latter will be of the greatest value. The strain on the horses will be severe, but it is no time to spare horseflesh when it is a question of converting a retreat into a rout. The pursuit is one of the few occasions when artillery should fire at night. Even if the enemy's columns can only be vaguely distinguished, and if ranging is mere guesswork, the horse artillery should keep up a vigorous fire. If only a few shells are effective, this will still materially help to demoralize the enemy.

TACTICS OF MOUNTAIN ARTILLERY.

One of the remarkable points about mountain warfare is the limited field of view obtainable. On the mountain on which the guns are posted, they will see little of the ground above or below them, and not much to either side, except the adjacent spurs. The foot-hills and the plain will be visible, and so will the opposite ridge: but though this may appear to be

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a plain slope, it will afford a surprising amount of cover from view. Therefore the mountain gunner's difficulty is rather where to go than how to get there. The mule may be trusted for the latter; wherever the gunner can go, so can the mule. But considerable skill and experience are required to select a position from which the artillery can fulfil the tactical task assigned to them. And in the mountains, if a wrong position be selected, it may mean an hour's delay to get to the right one.

The effect of the restricted field of view in mountain work will be that the opposing lines of infantry will get much closer to each other than in the plains, and owing to the rough ground these lines will be very broken and irregular. The mountain battery will therefore be in a normal state of "close support," and will mostly be within medium rifle range of the enemy. On the other hand, with skilful leading it will nearly always be possible to get into position without exposure.

The Mountain Howitzer.

In mountain warfare entrenchments will play a considerable part, as the irregularities of the ground enable these to be constructed with less labour than in the plains. Moreover steep cover, such as can be obtained behind rocks, will usually be available. It is therefore necessary to provide a weapon capable of searching entrenchments and steep cover with high-angle fire. The mountain howitzer, described in Chapter IV., has been developed with this object in

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view. The principles of its employment are the same as with the field howitzer. It can fire in any direction, irrespective of the front of the battery; it is effective against the detachments of the enemy's shielded mountain guns; and, on occasion, it can come out into the open, when it makes a powerful gun up to 2500 yards.

Semi-Mountain Equipments.

Austria is a country surrounded by mountain States, and the Austrian army expect to do a great deal of mountain fighting in the event of a war. The conclusions they have arrived at in respect to mountain warfare are therefore interesting.

They consider that mountain artillery should be divided into two classes, light and heavy Their light Q.F. 14 pr. pack equipment is of the ordinary type, capable of going anywhere. Their heavy 30 pr. 4 in. howitzer is also capable of going anywhere, if allowed to take its time. This weapon is not constructed for pack transport, but has a narrow-gauge wheeled carriage and limber, drawn by three mules or ponies tandem. Where the gun cannot go on its wheels, it is taken to pieces and packed on the trail, which forms a sleigh; this can be dragged over any ground, but the process takes time. It is considered that the movement of troops in the mountains will be comparatively slow, and that there will be time to get up the howitzers to strong central points whence they can fire in any direction. Moreover, it is not necessary that howitzers should be in view of the

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target, and the howitzer battery may be in action on a track 1000 feet below the level where the fighting is going on, while the battery commander observes from a mountain-top. With this object in view, the Austrian mountain howitzer batteries are fully equipped with appliances for indirect laying, including panorama sights and telephones.

Mountain Artillery in the Plains.

Although an army may possess mountain artillery, it will not always be fighting in mountain country. When fighting in the plains, the question of the best method of employing the mountain guns and howitzers arises.

Now a 14 pr. mountain gun, compared to the 18 pr., is but a feeble little field gun; still it has its possibilities. Its principal advantage is its handiness; thus the 18 pr. requires 6 ft. 3 in. between gateposts to get through a gate, whereas the whole of a mountain equipment can be passed through an aperture three feet by two. A mountain gun can be carried up to the flat roof of a building; if it were attempted to try similar tricks with the 18 pr. it would go through the roof at the first round. Mountain artillery can be ferried across a river in small boats, or landed with the infantry when troops disembark, the guns being then transported by hand. But the great advantage of mountain artillery is its power of acting in **close support** of the infantry.[1]

[1] This subject has been ably dealt with by Major Knapp, R.G.A., in the *Journal of the Royal Artillery*, September, 1910.

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The advantage of having guns close up to the infantry firing line is generally recognized. But many experienced officers are inclined to doubt the possibility of pushing forward horsed field guns even under long-range rifle fire, unless in exceptionally favourable country. And if the field guns have to be run forward by hand across country, this will be a slow and difficult process.

Now mountain artillery can find cover where field guns would be fully exposed. They can advance through the trees of a plantation, along the bottoms of ditches or the beds of streams, and get cover in slight hollows of the ground, or behind low hedges. A mule with its load is no higher than a man, whereas mounted men require 8 feet of cover to conceal them. A mountain gun is more difficult to stop than a field gun, in spite of the number of loads, because the components of each load, even the gun-loads, can be carried forward by hand if a mule is hit. Finally, if the mules cannot get forward the gun is much easier to run forward by hand over obstacles than a field gun.

It is very doubtful whether mountain artillery (or rather pack artillery) will ever be introduced as part of the divisional artillery, irrespective of mountain work, because the mountain gun affords less than half the fire-power of the field gun for the same expenditure on men and animals. But when mountain artillery is available it will certainly be most valuable for action in close support of the infantry.

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CHAPTER XXIII.

THE SUPPORT OF INFANTRY BY ARTILLERY.

General Principles.

The title of this chapter is in accordance with current phraseology, but it is logically unsound. The old idea was that the infantryman did the work in his own way, getting such help as the gunner chose to give him. The modern idea is that both work together, their action being mutually interdependent.

A line of men in the open cannot walk up to steady riflemen firing over a parapet or through a hedge. While on the move, their fire ceases or becomes ineffective. If other infantry are lying down and supporting the assault by their fire, this is masked by the men advancing. In order to place the attack on equal terms with the defence, the ~~latter~~ must be kept under continuous fire. This can sometimes be effected by oblique infantry or machine gun fire from a flank. But usually the only effective means of keeping down the fire of the defenders will be artillery fire from above—that is, over the heads of the men attacking. If a constant stream of shrapnel bullets is descending on the defenders, these will be

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kept crouching under cover, or bobbing up to deliver unaimed shots, till the attacking troops can get at them with the bayonet.

Two things are therefore required of the supporting artillery. The first is accurate continuous fire upon the defenders; the second is perfect co-operation with the attack, so that the volume of fire can be increased to the utmost when the attacking troops expose themselves by advancing, and so that it can be instantly stopped or diverted when they make their final rush.

Besides direct support, the attacking troops rely on their artillery for **protection** against the defender's artillery, against his infantry firing from other points of the position, and against counter attacks.

In the French army the artillery is divided, at the outset of the battle, into supporting and protective artillery. No such rigid classification obtains in other armies, and artillery commanders select their targets according to the exigencies of the combat. But at any given moment part of the batteries will be engaged in support, and part in protection, and it will be convenient to consider the two duties separately.

Action of the Supporting Artillery.

Before a battery can engage a given target, it must locate it. When the defender's line is well-defined, this is easy enough. But the defender will frequently employ small detached firing lines, such as short lengths of trench fitted to the folds of the ground. These will be carefully concealed, and the men in

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them will not open fire till the attacking troops arrive within 1000 yards or less. Even on a forward slope, open to the view of the artillery supporting the attack, these trenches may be impossible to locate from an artillery position some 3000 yards distant until the men in them open fire, and even then the artillery may not be aware of their existence till they see their own infantry checked. Therefore, the supporting artillery must not be content with a position affording a general view of the objective of the attack, but must push forward their guns, even if they have to advance under fire, to positions from which individual targets are clearly visible.

There is no sense in pushing forward restlessly merely for the sake of advancing. If the fire is fully effective at 3000 yards there is little to gain, and much to lose, by changing position to 2000 yards. But the battery commander must see his target; and, at the decisive stage of the combat, the layers must see it too. And the moment the artillery fire degenerates from accurate target shooting into mere area-searching, an artillery commander fails in his duty if he keeps his guns back.

This artillery advance may take time. We are apt to be misled by the manner in which attacks are rushed at manœuvres, in order to get the maximum of instruction out of the available funds. At manœuvres we should cross the Tugela in a day, and be into camp for dinner. On service the procedure is less rapid, and if the artillery can get forward half a mile in an hour they are likely to be

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advancing much faster than the infantry. It may be advisable to wait till the enemy are hotly engaged, when single brigades or batteries can make a dash over open ground before effective fire can be brought to bear on them. If it is impossible to get forward in the time available, the G.O.C. must be informed, and he may find it necessary to postpone the attack in order to enable the artillery to advance by night, and take up positions from which their fire will be effective. But if the attack pushes on, there is no possible excuse for artillery who fail to support their infantry because they cannot see the target. They must push forward until they do see it. If the infantry can get forward, so can the artillery, even if they have to take their guns forward by hand. If they cannot use drag-ropes, they must push their guns and wagons in front of them; they will still be much safer than the infantry, who have no shields to protect them. If the infantry can get over hedges and ditches, so can the artillery, though it may take more time.

It is desirable to lay stress on this point, because there still exist, in our own and other services, some professional prejudices which require uprooting. One is that artillery should never go near enough to the enemy to get shot; another is that artillery can do nothing without a horse in it. There are officers who, if they knew their teams would be shot to pieces if they advanced to help the infantry, would be content to remain behind and shoot vaguely at the landscape beyond the firing line. And when the

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remnants of the beaten infantry returned, these officers would still think that they had done all that could possibly be required of them. This is not the true artillery spirit; if the infantry want help, the artillery are there to give it, and must do so at whatever cost to themselves.

Limitations of Support.

When the advancing infantry get close to the enemy's line, the supporting artillery must cease firing or increase range and fuze (see *Artillery Fire*). The moment at which this is necessary depends principally on the ground. Thus if the enemy are behind a parapet at the top of a slope it may be possible to continue firing till our infantry are within 50 yards or less. The Germans lay down that "Under unfavourable circumstances the artillery may be obliged to cease firing when the infantry are within 300 metres of the enemy." The French lay down "about 300 metres" as the limit. According to our own experience in S. Africa, 300 yards is too great a distance for men to cross under infantry fire, and it is better to keep up the fire till our men are within 100 yards, or less.

Even if a few shrapnel bullets take effect on our own troops, they will suffer much less than if left unsupported.

In order to continue this support to the last moment, it is absolutely necessary that the supporting artillery should be in a position whence they have a good view of the target.

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Co-operation with the Infantry.

It does not follow that the artillery can see their own infantry because they can see the target. Even so, they will not know what the infantry mean to do, or when they mean to do it. In order to co-operate effectively with the infantry, the artillery must be in communication with them.

The joint action of the infantry and artillery is based upon operation orders, in which the G.O.C., assisted by the advice of his C.R.A., orders that, say, the 1st infantry brigade will attack the village A, supported by the 1st artillery brigade from a position at B. Now this order does not cover the whole conduct of the attack on A; it may be opposed by hostile artillery from C and D, and the C.R.A., as fire-commander, may have to protect the attack by turning his 2nd and 3rd artillery brigades on to the guns at C and D. But so far as the joint action of the 1st infantry and 1st artillery brigades is concerned, this order enables the two commanders to concert their measures. Before the attack commences, the O.C. 1st artillery brigade confers with the O.C. 1st infantry brigade, if possible personally, or at any rate by sending an officer to him. The gunner is informed as to the line of advance selected, and the method of attack; he informs the infantryman what support he can give, which successive positions, if any, he proposes to occupy, whether he intends to send forward any guns in close support, where his own observing station will be, and so forth. It may be possible

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to arrange for constant telephonic communication between the two commanders (see *Diagram of Communications*, Chapter XIV.). Failing this, communication by orderly or signal must be established by the artillery brigade commander.

In many cases—perhaps in most cases—it will be advisable for the supporting artillery brigade to send forward an officer with the infantry. His duties will be to watch the movements of the firing line, to locate any fresh targets that may be difficult to distinguish from the main artillery position, and generally to keep the artillery brigade commander informed as to the course of the combat. In exceptional cases he may have to act as ranging officer for a battery, but this is not his proper duty. His station will not as a rule be in the firing line, nor even close behind it; he requires to see what is going on without being shot. And since the infantry brigadier will endeavour to select a station affording the same advantages, the advanced artillery officer will usually be with the infantry brigadier, or near him. He communicates with his brigade commander by any means available, either through the divisional communication station, by a telephone line laid by his brigade, by a signal station established near his post, or, failing these means, by orderly. If he is with or near the infantry brigadier, he will be the representative on the spot of his brigade commander, and will undertake communication with him.

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Artillery in Close Support.

The French, when they adopted the Q.F. gun, introduced the system of sending forward small detachments of artillery, at the rate of about one section per battalion, to accompany the infantry up to close ranges, within 1000 yards or less of the enemy. They have now modified this system. Instead of detailing the batteries or sections which are to go forward with the firing line, they detail "infantry batteries," at the rate of about one battery per battalion, to advance in support of the infantry. These batteries send forward sections in close support if necessary; in extreme cases the whole of the infantry batteries may be up in the infantry firing line just before the final assault. Other nations still adhere to the idea of a main position, or rather positions, for the artillery, and a few guns in close support.

These guns afford encouragement to the infantry by their presence, but this is not the reason why they are sent forward. It is to be able to take on targets which suddenly appear, more quickly than is possible from the main position, and to afford intimate support in the complicated phases of the fight at close quarters, including local counter attacks. For instance, if the infantry suddenly find themselves opposed by an enemy behind a wall, it might take the main body of the artillery some time to range on it, while the advanced guns could send the bricks flying at once. A hostile gun posted behind lateral cover so as to bring oblique fire to bear upon the

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attack may be invisible to the guns in the main position, and therefore safe from them, but not from the advanced guns.

It is in intricate, broken country that the advanced guns will be most useful and will best be able to push forward. In a fight on open downs they would probably see less of the enemy than from the main position, even if they could get forward, which is improbable.

The "main position" has here been spoken of as if it were a well-defined ridge, where the main body of the artillery establish themselves and settle down to shoot with no idea of moving till the battle has been won or lost. This is a false conception. It has already been shown, under *Action of the Supporting Artillery*, that these must push forward when they can no longer clearly distinguish the targets opposed to their infantry. But it may not be desirable to advance a whole brigade because the infantry are checked by one machine gun which cannot be located. This duty is better performed by the advanced sections. These constitute a means of economizing artillery, by using small detachments to engage small targets. Moreover their handiness and insignificance may often enable them to get forward where large bodies of artillery advancing would draw the fire of every battery within range, and would suffer heavy loss.

It would be unsound to advocate the employment of sections advanced in close support as the standard method, to be adopted under every possible set of

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conditions. The only person who can possibly decide whether their use will be advantageous is the artillery commander on the spot.

Next to mountain guns, horse artillery, if available, are the best guns to send forward in close support, on account of their handiness. Howitzers are suitable in some respects, but their fire is too slow.

The tactics of advanced artillery are mostly determined for them by the ground. They will, of course, endeavour to keep on the flanks of the infantry, in order to divert fire from them instead of attracting it, and in order to bring oblique fire to bear on the targets in front of the infantry. They will use both concealed and open positions, but will always endeavour to occupy the position without exposing their horses, even if this entails running up a quarter of a mile by hand. They will use every possible means of advancing under cover, but must be prepared to make a dash across the open when no cover is available. When the enemy's troops are already hotly engaged, it will take his officers some little time to perceive a comparatively distant target, and more time to bring effective fire to bear on it. A section galloping at 15 miles an hour will cover half a mile in two minutes, and has an excellent chance of getting across unscathed.

The officer leading an advanced section must have a good eye for country, or he may find himself stopped by some obstacle under the enemy's fire.

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Action of the Protecting Artillery.

It is not considered desirable, in our own service, to make any rigid distinction between supporting and protecting artillery. The protecting artillery is that which, at any moment, is engaging the batteries firing on our infantry from places other than the point of assault. Since these constitute fixed targets, they are best engaged from concealed positions. If "knocking out" fire is impossible, as it usually will be, it will be desirable to concentrate the fire of the protecting batteries on the enemy's batteries in turn; this means good fire-control by the C.R.A., and this requires that these batteries shall not shift their positions more than is absolutely necessary, as a change of position interrupts both fire-effect and communications.

Howitzer batteries are the best adapted for engaging the enemy's artillery, since, as already explained, their shrapnel fire produces effect upon detachments behind shields more quickly than the fire of guns.

So far we have considered only the action of artillery with infantry in the attack. In **defence** or **retirement** the methods are the same in principle, both as regards support and protection, co-operation, and the use of advanced artillery. In **encounter** the situation at any point invariably resolves itself into attack or defence, and is dealt with accordingly.

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CHAPTER XXIV.

ARTILLERY WITH ADVANCED AND REAR GUARDS.

Advanced Guards.

The composition and strength of an advanced guard vary according to the duties required of it. Thus a **marching** advanced guard, at a distance from the enemy, is merely a scouting party intended to prevent the column from running its head into danger; a **protective** advanced guard is intended to ward off minor attacks, and to hold out if attacked in force till the column can deploy; and a **fighting** advanced guard is intended to seize positions and generally to overcome slight resistance without the trouble of deploying the main body. It may, in fact, be regarded as a skirmishing line of which the main body forms the supports and reserve. A marching advanced guard requires no guns. A protective advanced guard requires only a few guns (say one battery for a division) to prevent the enemy from getting within rifle range without being fired at; a fighting advanced guard is a complete fighting force, and requires the same proportion of guns as the division; thus if the advanced guard of a division

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consists of one infantry brigade, it should have one brigade of field guns, and one battery of field howitzers.

The tactics of the protective advanced guard, if attacked, are such as to secure delay. This is often best effected by an initial offensive movement against the enemy's advanced troops. In this, the guns should be handled boldly, and the advanced guard battery is best split up into sections. Bluff, not slaughter, is the object in view. Accordingly at this stage it is not desirable to become too closely engaged, and the guns should be withdrawn when seriously threatened. If exposed to superior artillery fire they may be run back under cover and re-open from fresh positions; with single sections this presents no great difficulty.

If the advanced guard is obliged to retreat, the guns must fight a delaying action. The enemy will endeavour to envelop and destroy the advanced guard before the main body can come up; to prevent this, a section of guns should be on each flank, or on the flank seriously attacked. The advanced guard guns can employ a rapid rate of fire, since the ammunition will be replaced when the main body comes up. If they have expended their last round just as the wagons from the ammunition column reach them, their rate of fire will have been tactically correct.

The artillery with a fighting advanced guard will be handled in the same way as with any other force which is taking a vigorous offensive. The object is to defeat the enemy's advanced troops before they can

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be reinforced; and this requires dash and boldness. Enveloping tactics are most effective, and the artillery should endeavour to occupy advanced positions on the enemy's flanks. When horse artillery are available, they will be more useful with the advanced guard than field guns.

Even a protective advanced guard can do a certain amount of reconnoitring. Thus if the column is stopped by a hostile force on a hill, the advanced guard commander should endeavour to get round both sides of it, which will oblige the enemy to disclose his strength. The artillery will here be of assistance in drawing the enemy's fire.

Rear Guards.

A rear guard may be a mere baggage guard, or a small force to keep off hostile mounted detachments, or a fighting rear guard protecting the retreat of the main body. It is only in the last case that guns will be employed. The proportion of guns will vary; but in the case of the retreat of a defeated force, it may be said that practically the whole of the guns will be left with the rear guard. Good troops, retiring slowly, can mostly prevent the enemy from getting *through* them; but it is more difficult to prevent the enemy from getting round the flanks of the rear guard, as he will certainly attempt to do. Therefore the artillery should be widely dispersed, and should hold as wide a front as it is safe to occupy. The main strength of the artillery should be on the flanks. The horse artillery and mounted troops will be either

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in prolongation of the flanks, or acting independently beyond them; the howitzers and heavy guns should make for commanding central positions, and the field guns should form the main line of defence. Thus in the retreat of a division one brigade of field guns will be on each flank, and the batteries of the third brigade distributed along the line, as in the annexed diagram.

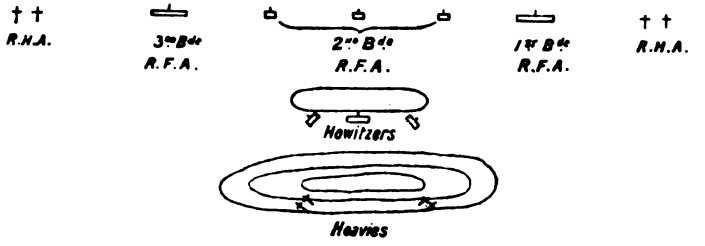

FIG. 121.

The retirement of the rear guard will be timed in accordance with the progress of the main body, in order that the two may not become too widely separated. The artillery brigades will retire by batteries to positions previously reconnoitred in rear, the first-line wagons being sent ahead. The light ammunition columns will await the brigades in each successive position, and, having supplied them with ammunition, will at once retire to the next position.

The above is the theory of a retirement as carried out by steady well-disciplined troops who, like the Tenth Legion, are "equal to either fortune." But infantry retreating are apt to become disheartened, and it is the business of the gunners to keep their spirits up by close and effective support, undeterred even by the prospect of losing their guns.

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CHAPTER XXV.

ARTILLERY IN ATTACK, DEFENCE AND ENCOUNTER.

General Principles.

Our own methods of training have been criticized on the ground that we attach undue importance to the attack and defence of positions. Now the history of the last two wars affords some justification for our ideas. In almost every battle fought in S. Africa and Manchuria one side held a position and the other side attacked it. Even supposing that two armies charge at one another like the knights of old, then at any given point of the line of battle one force will be attacking and the other defending a position, even if it be only a hedge occupied at a moment's notice. Whether we have to deal with a company in a ditch or an army entrenched, the tactical methods are the same in principle, differing only in degree. Even in the extreme case of the battle of encounter, as soon as battle is joined the combat at any point resolves itself into a fight for a position. If, therefore, we consider the general case of the attack and defence of a position, this will cover the tactics of the minor phases of the combat.

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In the present chapter it is proposed to deal only with the combat by daylight. But many good authorities believe that in future warfare night operations will be rather the rule than the exception. The modifications in tactics entailed by fighting in darkness, or by artificial light, are considered in Chapter XXVI.

THE DEFENCE OF A POSITION.

It is unusual to place the defence before the attack, but as a matter of fact a position is prepared for defence, however summarily, before it is attacked, and the attacker has to take it as he finds it.

The popular idea of a position is a commanding crest with a glacis slope in front of it. A real position may be the edge of woodlands, or of an area covered with buildings, or any other natural or artificial feature which affords concealment to the defence and denies it to the attack. In the following paragraphs the term "crest" is used to signify the edge of the position from which a clear view is obtainable.

The strategy of the defence of a position varies from the extreme active, when the defender merely lies in wait to strike, to the absolute passive, or to the elusive methods adopted by the Boers. In the first case the actual defence is a sham, intended to make the attacker deploy in a disadvantageous formation, while the bulk of the defending force is held in readiness to attack him. In the second case no decisive result is aimed at other than that of gaining time and

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immobilizing a certain number of attacking troops. A good instance of this is the defence of the lines of Torres Vedras, where Wellington is reported to have said, "I can go out and beat the French at any time, but it would cost me 10,000 men, whom I cannot spare." The third method is only of value as leading up to the first; the attacker is weakened by taking successive positions at a heavy cost, while the defender suffers little, till he can be attacked in turn. In the ordinary defence of a position, by a weaker force than the attack, the three methods are combined.

The **extent of the position** to be occupied depends on the predominance of one or another of the three methods adopted. Thus for an active defence at least half the infantry of the force will be held in reserve for the decisive counter attack. The front which can be held by the remainder varies according to the openness of the foreground, but may be roughly estimated at from two yards a man for the extreme active down to half a yard a man for the extreme passive; but in the latter case only a quarter of the infantry will be in reserve. For the purposes of this chapter it will be assumed that an infantry division of twelve full battalions holds a front of four miles.

The **advanced defence** of a position is intended to delay the enemy, to inflict loss upon him, and to afford an opportunity of delivering local or general counter attacks. He must be deceived as long as possible as to the location of the real position. For instance, if he can be deluded into deploying to attack

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the sham position A, he can be attacked in flank from the real position at B. A skilled commander is not likely to make such a mistake on the large scale; he

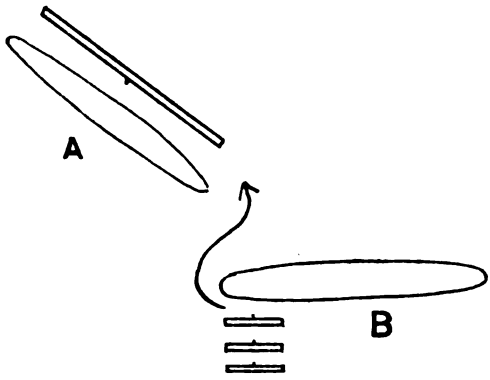

FIG. 122.

will feel his way before committing himself; but an alert defender, making skilful use of the features of the foreground, will always have an opportunity of delivering effective local counter attacks, unless the attacker's advance is very slow and cautious.

The above considerations enable us to form an idea of the tactics of **artillery in the advanced defence.** The attacker must be induced to believe that each successive sham position is the real one, and must be obliged to deploy to attack it; if he attempts to envelop it, his flank will be exposed to attack from the real position. A small and active force of artillery must be employed, horse artillery being the best, if available. The batteries are best split up into sections. They will open fire on the enemy as soon as he is visible, in order to force him to deploy at the greatest

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possible distance. As soon as a section is located by the attacking artillery, it will shift, say, a quarter of a mile to a flank and reopen fire. Concealed positions may be used while the enemy is still distant. To support the local counter attack, the guns must come out into the open, disregarding the enemy's artillery fire. Dummy gun-pits may be useful if time permits of their construction. When the infantry retire, the guns wait as long as it is safe to do so, then run back, limber up, and gallop after the infantry. If the defenders can succeed in delaying the attack till nightfall, it will then be advisable to withdraw the guns to the next position, as they can be of no use in the dark. When retiring by daylight to a fresh position, the guns should not drive up the front slope and come into action rear on the top, but should disappear round a flank.

During the advanced defence, the guns in the main position keep out of sight and remain silent, except to support a counter attack by the main body.

The **artillery defence of the main position** is directed towards bringing an overwhelming fire to bear on the decisive attack, and to giving effective support to the local and decisive counter attacks. Unless it is possible to predict the line of the decisive attack before the enemy arrives, positions commanding all possible points of attack are prepared and entrenched so far as time permits. On the large scale, this may involve the preparation of a position far more extensive than that which it is intended actually to hold. The fact that much labour has been expended on

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entrenching should have no weight if the enemy's movements are such as to render another position preferable.

When the line of the decisive attack can be determined or predicted, the artillery take up their final positions. The greater part of the guns will be in concealed positions, such that the flashes are not visible, behind the infantry line. But to repel the decisive assault it will be necessary to run the guns up to the crest, and to use direct laying. Since any movement of horsed guns will be impossible under the enemy's shrapnel fire, the concealed positions must be such that the gun can be manhandled to the crest. This means that the concealed positions will only be about 200 yards behind the crest, exposed to the enemy's searching fire, and should therefore be entrenched. It is also desirable to entrench the crest positions, provided that this can be done without making them conspicuous, and enabling the enemy to range on them beforehand. Dummy entrenchments on the crest may sometimes be used, but their vicinity will be decidedly unsafe for infantry.

It is essential that **the near foreground shall be under artillery fire**. It is often impossible to see the foot of the forward slope from the crest. The best method of sweeping it is then to post guns behind lateral cover, as at A, Fig 117, Chapter XI., so as to bring an oblique fire to bear on the front slope. If this is impossible, they must be posted on the front slope or at foot of it as at B. These guns must be

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well entrenched, if possible with overhead cover, and carefully concealed. They must reserve their fire till the last moment, as when the enemy locates them he will turn a battery on to each gun, and fairly blow it out of the ground. It will be impossible to withdraw these guns under fire, or to replenish their ammunition; and if posted in the wrong places they cannot be shifted till nightfall.

Balloon guns, at the rate of two per division, should be posted about two miles apart, preferably on heights behind the position from which a clear all-round view is obtainable.

When the batteries of the defence are in position, they will be connected by telephone and flag with the station of the C.R.A., which must be well entrenched and provided with overhead cover. The infantry defence is divided into sections, but it is not advisable to place the artillery under the commanders of sections, as this would interfere with massing their fire. The defence of a deliberately-prepared position affords the C.R.A. an ideal opportunity of concentrating the fire of dispersed batteries, up to the moment when the decisive assault comes to close quarters. Cross observation, fire-charts, and other siege artillery means of measuring ranges and observing fire can be used. The foreground having been carefully reconnoitred and mapped, if an enemy's battery can be located in a certain hollow, two brief orders should suffice to bring an effective cross fire to bear on it. **Aeroplanes** may be of the greatest use in locating the concealed artillery of the attack.

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The artillery of the defence should not reply to distant fire, nor engage small distant targets. But if the enemy exposes himself within effective range, a storm of fire from the guns in the concealed positions should be delivered. If the heavy artillery can command roads or other defiles, even within long range, by which the enemy must approach, they may delay his movements considerably. Howitzers should preferably be used for engaging the enemy's artillery; mountain guns, if available, are posted on the front slope.

When the decisive attack is launched, the guns are run up to the crest to repel it. The guns of the attack will also be run up to the crest; but it is not advisable to take batteries off the advancing infantry to fire at them, as effect upon shielded guns is slow and uncertain, and the infantry afford a better target. But guns and howitzers from other parts of the position, if they cannot be advantageously turned on the infantry, should engage the batteries of the attack. Their oblique or crossed fire will be more effective than the frontal fire of guns directly opposite. It is important to silence the guns pushed forward in close support of the attack, and these should be engaged in preference to the more distant artillery.

At the decisive stage, the defender's guns on the crest will require a liberal **supply of ammunition**, and, in view of the difficulty of running up wagons under fire, it is a good plan to carry ammunition up beforehand, before the guns are run up. As soon as the batteries take up their concealed positions, the first-

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line wagons should be brought up and posted beside the guns (making two wagons to each gun) and the ammunition columns should be parked between the brigades, the horses being withdrawn. This is necessary, because no movement of horsed wagons will be possible at a later stage, under shrapnel fire. Keeping the ammunition columns back lest they should be captured in the event of a retirement is a half-hearted measure, conducive to defeat.

It is not advisable to keep any **artillery in reserve** in the defence of a position. It has been assumed that an infantry division, with 96 guns, will occupy a position four miles long. This gives a target front of 100 yards per gun, or 600 yards per battery. Even if only one mile of the four be seriously attacked, this gives 150 yards of target per battery, which is quite enough. Moreover, keeping guns in reserve, so as to be available when required, is easier said than done; they may be posted a mile in rear of the position, but considerable difficulty will be found in bringing them up, under shrapnel fire, when required.

Counter Attacks.

These may be local or general, carried out during the advanced defence or defence of the main position. During the advanced defence, the guns in the main position, which have so far been held in reserve, are available to support a general counter attack, while the advanced guns accompany it in close support. During the main defence, if a general counter attack

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is launched, it will usually start from a point other than that on which the decisive attack is directed, so as to take the attacking troops in flank, not to meet them. It will be accompanied by a few sections of guns, taken from the position, in close support, while the remainder of the artillery run up to the crest to support it. If the general counter attack is to be pushed home, and if it means that the whole force takes the offensive, the tactics of the artillery will be as in the attack. The position which has been defended becomes the original main artillery position taken up in support of the attack, and as the counter attack pushes forward on to ground where the fire from the main position is no longer effective, brigades and batteries are advanced to fresh positions, previously chosen, in support.

If the enemy's assault on one part of the position is successful, it by no means follows that the whole position is lost. The defending line will not necessarily be broken, but may only be bent back. The assaulting troops will then find themselves in the centre of a semi-circle of fire, and if they can be prevented from receiving immediate support they may find the position untenable. The guns in distant sections of the defence should immediately open on the captured point. If the whole of the ground has been mapped, so that the C.R.A. has a complete fire-chart of it, it should be possible to open effective fire at once. Batteries so placed that they cannot effectively fire on the point of assault should be shifted as soon as possible to covering positions at short range. The

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guns on the crest, in sections adjoining the point of assault, must use every endeavour to prevent reinforcements—especially artillery—from reaching the captured point.

THE ATTACK ON A POSITION.

Preliminary Stages.

The position will have been generally located by the cavalry reconnaissance, but more definite knowledge is required before the troops are committed to a deployment in any given direction. It is necessary to drive in the advanced defence and get in touch with the real position. This is not done by putting in masses of troops, who would suffer severe loss, but by using a comparatively small number of active troops. The enemy's resistance cannot be strong at all points, unless he denudes the main position of men; it is the duty of the attacking troops, at this stage, to penetrate his weak points, get round his unprotected flanks, and manœuvre him out of one advanced position after another. The force of artillery required will be relatively small, say one section per battalion. Horse artillery or mountain guns are the most suitable. The force employed in the preliminary attack will require a reserve, in case of local counter attacks, and a brigade of artillery will be held in readiness to accompany or support it. The remainder of the artillery will be disengaged from the columns and formed up in positions of assembly, in communication with the C.R.A., so as to

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be immediately available in case of a general counter attack.

If the enemy's advanced troops offer serious resistance it may be necessary to deploy a larger proportion of the attacking force, and to bring several artillery brigades, or even the whole of the artillery, into action to support it. The reason for using artillery fire, in preference to infantry fire, in this case, is apparent from Fig. 122. If a large force of infantry be put in before the enemy has been located, it will be liable to be attacked in flank, or to be overwhelmed with a storm of fire from concealed guns; while artillery 3000 yards behind the infantry are in no danger.

The Attack on the Main Position.

When the enemy's position and flanks have been located, the real attack commences. It is convenient to consider this as a separate stage. But, to quote F.S. Regulations, section 103, "the decisive attack is the culmination of gradually increasing pressure relentlessly applied to the enemy at all points from the moment when contact with him is first obtained." The word *relentlessly* is especially significant. The attacking force, being presumably the stronger, can afford to keep up a continuous attack, night and day, relieving the troops in immediate contact with the enemy before they are worn out. Our spasmodic attacks in the early battles of the S. African war are a good example of how not to do it.

The attack may be frontal or enveloping. Strategically, an enveloping attack may be considered as

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two or more converging frontal attacks, and the tactics of each are the same.

The commander may elect to apply equal pressure to all parts of the enemy's line, or to several parts, hoping that one will give way, or to concentrate his force against one part only. The latter is the usual method, and it will here be assumed that this procedure is adopted. In any case no part of the enemy's line must be relieved of pressure, and this means that artillery must be disposed to fire on the whole length of the position. The ideal is to attack the enemy along the whole line, keeping him in ignorance of the point against which the decisive attack is to be launched till the last moment. But it is possible that the enemy's **aeroplanes** will render this difficult to realize.

The aeroplanes of the attack will be of great use in the preliminary stages of locating the position. But it is not likely that the information supplied by them will be sufficiently accurate to locate the exact positions of the defender's artillery, so as to permit his concealed batteries to be ranged upon. Photographs taken from a balloon may possibly give more definite information.

The attack of an obstinately-held position is not a matter of a single day or night. Even the preliminary stage may take two days, and the approach to within striking distance may take several days more. Except in very favourable country, the massing of artillery and infantry opposite to the point selected for the decisive attack will have to be carried out at night.

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It will nearly always be desirable, in a deliberate attack, to place the C.R.A. in independent command of the whole of the artillery. He will have plenty of time to establish an efficient system of communications, and to carry out his reconnaissance.

As soon as he has been informed as to the point of assault selected, he will allot positions to the artillery supporting the assault. The artillery previously in action opposite to other points of the position will now be replaced by single sections, keeping up an intermittent fire, and changing position frequently. The positions commanding the point of assault are selected in accordance with the duties to be performed by the batteries and brigades, which will be divided as under. But this division of duties can only be provisional, and the C.R.A. must have complete control of the fire of all his batteries in order to employ them as required by the exigencies of the combat.

The artillery of the attack will be divided as follows:

1. Single sections engaged in the holding attack.
2. Batteries supporting the assault.
3. Batteries engaging the enemy's artillery.
4. Batteries employed to cut off the point of assault.

The batteries supporting the assault will have the best positions, as close up as possible. These should preferably be concealed positions from which the guns can be run up to the crest; in any case the guns must be in the open or semi-concealed position when

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supporting the final stage of the assault. An enveloping or at least converging fire upon the point of assault should be obtained if possible; but a good view is the principal consideration.

The batteries engaging the enemy's artillery should be in concealed positions, howitzers being preferably employed. These also must have a good view of the point of assault.

The batteries cutting off the point of assault have to keep up continuous shrapnel fire on a zone on either side, so as to prevent the enemy from reinforcing it. One battery on each side should be quite enough for this duty. These batteries will have the worst of the available positions.

Besides the above artillery, **balloon guns** will be posted singly at points affording a good view in all directions, bearing in mind that the enemy's dirigibles and aeroplanes will approach rather from the rear than from the front.

A preliminary bombardment of the point of assault would only serve to attract attention to it. The batteries are kept silent until the enemy discovers the advance of the infantry and opens fire on them. Ranges to all likely points on the crest will then be obtained and registered as soon as possible, since the defender's guns and infantry must appear on it at the decisive stage. If any guns on the forward slope can be located, a heavy fire must be directed on them and maintained even after they have been silenced, as if these guns reopen fire they will inflict heavy loss on the infantry, while if they are destroyed

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the dead angles which they have presumably been placed to protect will be of great service to the attacking troops.

It may or may not be advisable to send forward sections in **close support**, taken from the batteries supporting the assault. These should be employed unless the position of these batteries is within 2500 yards of the crest, and affords a clear view of the ground at the point of assault.

Complete communication with the infantry must be arranged for as explained in Chapter XXIII. In the deliberate attack it will usually be possible to provide telephonic communication.

At the decisive moment the rate of fire is increased to the utmost. Each battery keeps a sharp look-out on the infantry which it is supporting, and increases range and fuze as soon as they get within 100 yards of the enemy's position.

Crowning the Position.

If the assault succeeds, the assaulting troops will find themselves exposed to a converging fire, and are likely to suffer heavily unless effectively supported. Perhaps the most effective method of support is to press the holding attack at other points, and deliver other assaults wherever possible. But this only indirectly concerns the artillery. In any case reinforcements must be quickly poured into the point where the enemy's line is broken or bent back, in order to roll up his force along the crest to both flanks at once.

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The advanced guns, sent forward in close support, will naturally be first to reach the captured position. It is a moot point whether the whole of the remainder should advance at once, or whether part of the guns should cover the advance by engaging the defender's artillery. But since such covering fire is not likely to be immediately effective in silencing the defender's guns, and since it is all-important to take immediate advantage of even a partial success, it may be said generally that all the attacking artillery should press forward boldly, without waiting for orders. If the attacking infantry have been able to advance under fire, there is no reason why the artillery should not do the same, even if they suffer heavy loss.

If the attack fails, the artillery maintain a rapid rate of fire till the defeated infantry have got under cover.

In the attack, it is not advisable to keep any **guns in reserve**. The only possible use for them is to repel a counter attack. But a local counter attack can be dealt with by the advanced guns and the guns in the main position; while a decisive counter attack, on the large scale, takes time to deliver. It will be met by delaying tactics on the part of the troops opposed to it, and there will be plenty of time to shift the batteries of the attack from their concealed positions to act in support of the general reserve.

The tactics of the attacking artillery, as above outlined, require a large **expenditure of ammunition**. The first-line wagons must be close up, and the brigade ammunition columns should be as close at hand as possible. If the brigades occupy concealed positions

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at night, it will be advisable to bring up the ammunition column wagons to the positions, withdrawing the horses out of range.

ARTILLERY IN THE BATTLE OF ENCOUNTER.

General Principles.

When two hostile forces are in the same neighbourhood, they, or their advanced guards, will often come into contact unexpectedly. "The long columns then quickly deploy for the battle of encounter."[1]

When the vanguards of the two forces meet, neither antagonist has any great force on the spot. If the rate of deployment of the two forces is equal, the force which strikes hardest at first will gain an initial advantage. Therefore the artillery of the advanced guard should be worked to its full capacity. If there is no target in view, the guns should be pushed forward till they meet one. They should not merely take up a defensive position to cover the deployment of their force. The best defence consists in attack, and even if the commander of the force does not wish to take the offensive till he knows what is in front of him, he should, if possible, begin with a movement in advance. If he can gain a mile of ground this will give him space and time to make his dispositions for attack or defence.

In any case, even if an immediate retreat is decided upon, the artillery must be disengaged from the columns of march. They must deploy, whether to

[1] German F.A. Regulations.

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support the attack or to cover the retreat. Of course, the presence or absence of a strong position may determine their movements, but, apart from this, they should face the enemy as quickly as possible.

If a Red column blunders into the flank of a Blue column, then the latter immediately turns and becomes a line. If the Blue commander takes advantage of his opportunity, the head of the Red column is likely to suffer severely, even if Red be the stronger force. The Blue commander should handle his artillery brigades boldly, pushing them forward on both flanks so as to envelop the head of the Red column before it can deploy. The Red commander must meet this by deploying his artillery on a level with the head of his main body, or even further back, while his advanced guard, reinforced by batteries from the main body, fights a delaying action.

In an ordinary case, where two columns marching in opposite directions meet, both deploy as quickly as possible, and the battle becomes one of attack and defence, or possibly assumes a mixed form, one force attacking on the north flank and the other on the south. The tactics of the artillery will then be as already described under *Attack* and *Defence*.

In future warfare, the employment of **aeroplanes** will do much to dispel the fog of war, and unexpected encounters will be less frequent. But if one side only possesses aeroplanes, it will manœuvre at an immense advantage, and if an enemy's column is reported approaching it should be possible to arrange a trap for it to march into.

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CHAPTER XXVI.

ARTILLERY IN NIGHT OPERATIONS.

Owing to the great fire-power of the modern gun and rifle, the difficulty in approaching the enemy, over ground affording no cover from view, will be very great. Even when such cover is present it will afford no concealment from observers in balloons and aeroplanes, which can communicate with their forces by wireless telegraphy.[1] It is therefore quite possible that in future operations will be conducted principally by night, with a searchlight to every battery and battalion. At present this stage has not been reached, and no army has attempted to provide means of illumination on the large scale. The usual modern method of conducting night operations is therefore to approach within close range under cover of darkness, and then to fight by daylight.

The terms "darkness" and "daylight" require some qualification. Thus it is a very common experience to get a misty morning, when objects are visible at a quarter of a mile, but when no shooting is possible beyond that distance. Again, during the

[1] Aeroplanes can send wireless, but cannot receive, on account of the noise of the engine. Dirigibles can both send and receive.

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hour after sunset the light will be good enough for movement, but troops at medium ranges may be quite safe from artillery fire. Similarly a thunderstorm may enable troops to cross exposed ground in safety. Darkness and thick weather favour the attack, and artillery and infantry must be prepared to take every advantage of them.

Success in night operations depends principally on careful reconnaissance of the ground. We had a lesson at Magersfontein on the folly of launching troops into unknown country in the dark. And this applies especially to artillery. When artillery have to move at night, they must know every foot of the ground; if they cannot reconnoitre by daylight, they should reconnoitre on the previous night; and if this is impossible they must be preceded by officers' scouting parties, and must keep back till the road is reconnoitred for them. The technical procedure in occupying a position at night has been described in Chapter XIX.

Next to reconnaissance, careful organization and timing of movements by night is of the highest importance. If two units cross one another in the dark, much confusion will ensue. If one unit marches into another, they are as likely as not to fire at each other; this happened on both sides in the Franco-Prussian War.

Since night movements are difficult and dangerous, every endeavour should be made to get over as much of the ground as possible before complete darkness sets in. Before the actual night march, artillery will

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be pushed forward as far as they can safely go, and assembled in positions of readiness.

Artillery on a night march, if not in the column with the infantry, should always be preceded by an infantry escort, otherwise they may be stopped by a few hostile patrols.

On the **defensive,** the object is first to prevent the enemy from reconnoitring the ground in front of the position, and secondly to stop him if he attempts to cross it in the dark. He may be prevented from reconnoitring by daylight by small advanced detachments of infantry and artillery; but to prevent him from reconnoitring in the dark will be a difficult matter, unless a large number of troops are employed.

The advance of the attacker in the dark may be stopped with a comparatively small number of troops. The defender has, or ought to have, this advantage, that he knows the ground thoroughly. He should post small detachments, varying from six to thirty men, to fire into the enemy's columns. The general idea is to let the advanced guard through, wait till the main body passes, and open magazine fire into it; then move at once to a fresh position, leaving the enemy to charge with the bayonet at the place from which the flashes came, and to find no one there.

Artillery can be employed to command defiles and to fire down straight roads. Horse artillery is to be preferred, since the guns are light and easy to handle; the horses will be kept well in rear, and the guns transported with drag-ropes. But it is an open

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question whether machine guns are not better than artillery for such work.

The defending force, if well posted and composed of picked troops, should have no difficulty in stopping the enemy's night advance in close country, when he is more or less confined to the roads. On open ground, where the enemy will advance in a line of columns, it will not be so easy to stop him. But considerable damage may be done by a few well-placed guns, and it is possible that the enemy may be

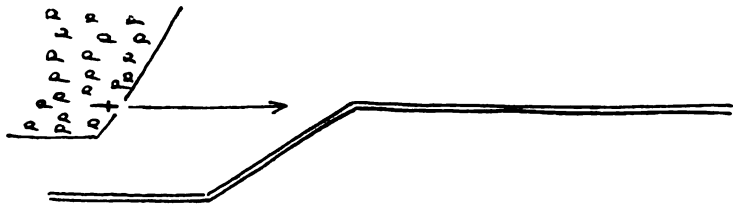

Fig. 123.

so checked that he finds himself in the open, and under the fire of the guns from the defender's position, at daybreak.

Night fighting of this description requires the most careful organization to prevent the defending detachments from firing at each other, and it requires good troops and good leading to make the men reserve their fire.

The **attacker**, if resistance is anticipated, should detail a small advanced guard to each column (about 10 per cent. of the force), and should give each advanced guard two hours' start from the position of assembly. It will be impossible to thoroughly reconnoitre close country in the dark; still, cover in

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the immediate vicinity of the road, as in Fig. 123, can be searched. The progress of the advanced guard will be very slow, and it should start as early as the darkness permits. Guns with the advanced guard will be useless; the artillery should march in rear of the main body.

FIGHTING BY ARTIFICIAL LIGHT.

This is not at present likely to be attempted on the large scale. Still, occasions will arise, in the attack and defence of a position, and especially in the advanced defence of a fortress, when this method will be used.

The means of illumination are:

The electric searchlight.
The acetylene searchlight.
Star shell.
Fixed lights.

The electric searchlight consists of a projector, usually 36 in. in diameter, and a dynamo and engine on a separate car. The light can be used as a concentrated beam, which is a narrow pencil of intense light, or as a dispersed beam giving a milder illumination over a front of about 100 yards at 1000 yards.

The acetylene searchlight is similar in effect to the electric light, but is more compact and more easily transportable. However, these lights have hardly yet reached the practical stage of development. When they are perfected they will probably lead to

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the increased use of illuminants, as several can be carried in one wagon.

Star shell have already been referred to in Chapter IX. They are available up about to 2000 yards, and give a very poor light for shooting, but may serve to detect advancing troops.

Fixed lights are usually magnesium lights set about 100 yards in front of the defences, and carefully screened from them. They are fired by electricity, or by a string and friction tube, and burn some 5 minutes. Piles of straw serve the same purpose.

For artillery purposes the searchlights, which are all under one engineer officer, are placed at the disposal of the C.R.A., and the engineer officer illuminates the targets as the C.R.A. directs. The method is to pick up the target with the concentrated beam, and then to illuminate it with two dispersed beams. Considerable experience is required in directing the lights, as the beam of light is opaque—that is, the observer can see into it, but not through it—and if a beam be thrown across the front of a battery it will effectually screen the target. Advanced observers are pushed forward, if possible, to within 2000 yards of the target, and at this distance observation, either of time or percussion shrapnel, is comparatively easy. In clear weather, the distance of the lights from the target makes but little difference, but a shower of rain or even a slight mist is sufficient to render the lights ineffective.

A searchlight flashed full on advancing troops will

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dazzle them, but this is not the case with artillery. The guns can continue to lay with the telescope on any illuminated object in the vicinity of the enemy's searchlight, or on the searchlight itself, with the open sights, if a piece of paper be held over the backsight notch.

It is not easy to hit a searchlight with a shell, on account of the difficulty in getting the range. But with cross observation (Chapter X.) the range can be measured with considerable accuracy, and searching with shrapnel will then prove effective, provided that the light is within medium range. However, the working parts of the searchlight occupy only a small space, and bullets through the projector, unless they hit the lamp itself, will not "douse" the light. It is therefore desirable to burst the shrapnel close up, so as to get a dense bullet-cone.

In the **attack**, searchlights are best kept doused until the defender discovers the attacking troops; these are then screened by beams crossed in front of them, while other beams are directed on the point of assault, both to dazzle the defender and to guide our own infantry. This means that the searchlights must be posted well on the flanks to avoid showing up our own troops. The artillery of the attack open fire as soon as the point of assault is illuminated. When the position is captured the searchlights are immediately deflected right and left on to the adjoining parts of the position. But before this moment the artillery must increase range and fuze to avoid killing our own men.

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One of the principal difficulties which the artillery have to contend with is the impossibility of distinguishing our own men from the enemy by artificial light. Communication with the firing line is therefore essential. The telephone is unreliable, as the chances are in favour of the cable being broken by the advancing troops. Lamp signalling by artillery officers following in rear of the firing line is the best method.

Star shell may be used to guide our troops or to fire at another point of the position in order to divert the enemy's attention. If this is done, a sham attack should be made on the illuminated point and a small number of guns told off to fire on it. The light given by star shell is too uncertain to enable the artillery to afford effective support to the infantry.

In the **defence**, success depends upon careful reconnaissance and preparation. It should be possible to find points in the foreground at which the attacking troops, if they advance, must come into view. These points should not be continuously illuminated, but the angles to them should be recorded on the training circle of each searchlight, and the beam should suddenly be dropped upon them from time to time. If the beam be swept round slowly, the attacking troops will lie down as it approaches them, and will then be difficult to distinguish. The ranges to these points having been previously measured, the artillery of the defence should be able to open effective fire upon them at once if troops are located there.

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Sometimes attacking troops may imitate torpedo boat tactics, and wait till the light is taken off to rush across exposed ground. This may be frustrated by quickly swinging the beam back again, or by opening a second beam, previously doused, on the same point.

The artillery of the defence will have an easier task than that of the attack. If they have no troops out in front, there will be no risk of confusing friend with foe. Their fire will be principally on areas to which the elevation and fuze have already been recorded, and it will be sufficient for them to know that hostile troops are in these areas in order to keep them under effective fire.

Fire from the concealed position is less interfered with by darkness than firing by direct laying, since the clinometer and aiming point can be used as well by night as by day. The technical procedure has been described in Chapter IX.

When hostile troops have been located, the lights should be kept on them ; but it must be remembered that these are not likely to be the only troops in the field. When the artillery have got their range, they can continue firing even if the beams be temporarily taken off the target to search for other troops.

If the attacking troops get within close range, the procedure of the artillery is the same as by daylight. Fixed lights will be of great assistance, and even star shell, fired from concealed positions, may be of use. In the defence, it is not desirable to fire star shell from guns or howitzers in the open, as if one bursts

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at the muzzle (as they are apt to do) it illuminates the firing battery.

If the enemy succeed in getting the range of a searchlight, and if shrapnel bullets begin to patter round it, it should immediately be doused and shifted to a fresh position. This is facilitated by the fact that each searchlight has 200 or 250 yards of cable connecting it with the dynamo car. The latter should, if possible, be protected by overhead bullet-proof cover.

It is possible that **balloon guns** may be effective in making direct hits on searchlights, as the flame from the smoke composition leaves a luminous trail. But experience in this direction is so far wanting.

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CHAPTER XXVII.

FIELD ARTILLERY IN FORTRESS WARFARE.

General.

It is not proposed to discuss the employment of field artillery in the attack upon the fortress itself, nor in the defence of the forts or enceinte, but only its action in the preliminary fighting outside the fortress.

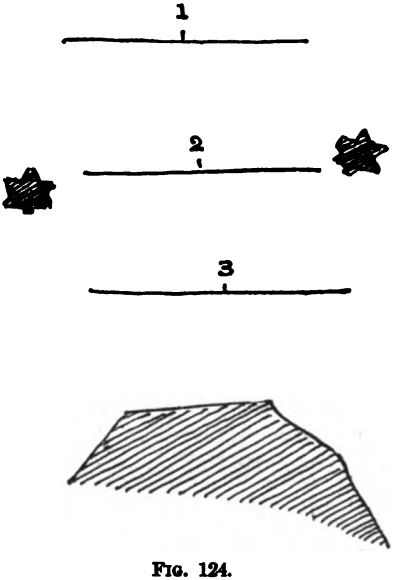

Fig. 124.

The French, who have always been leading authorities on siege operations, divide the exterior defence of a fortress into several stages. When hostile forces approach the fortress, the defenders must get into touch with them as soon as possible, and reconnoitre their strength and dispositions. When the attacker has

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disclosed his line of attack, the defenders occupy previously-prepared positions outside the line of the girdle forts, the flanks of these positions resting on points which are under fire from the forts. When driven back by superior force, they retire to a second line of positions in the intervals between the girdle forts, from these to a third line of positions under the guns of the fortress, and finally into the fortress itself.

The general tactics of the besieged at this stage may be styled **elusive defence**, similar to the methods employed against ourselves by the Boers, the object being to cause the maximum of loss and delay to the attack, with the minimum expenditure of men. But these tactics must be combined with a vigorous offensive whenever opportunity arises. In counter attacks **by night**, the besieged, owing to their knowledge of the ground, should enjoy a considerable advantage.

Artillery of the Besieged.

If any regular horse or field artillery are included in the garrison, they will be of great service in supporting the distant reconnaissance of the enemy. But it is probable that the mobile armament will consist of old-pattern field guns, either B.L. or Q.F., horsed with mobilized teams. These will hardly be capable of movement out of a walk, and their action in support of the reconnaissance will be limited to covering the retreat of the reconnoitring troops. Since every range and position within ten miles of a

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fortress should be familiar to its defenders, these guns, firing preferably from concealed positions, should be able to do considerable damage, and will assist in delaying the enemy's advance till the first line of positions has been entrenched.

In the first and successive lines of defence, the action of the artillery will be similar to that already discussed under the *Defence of a Position.* A dirigible, aeroplanes, and searchlights now form part of the equipment of every large fortress, and the besieged will no longer, as in former days, be kept in ignorance of the enemy's strength and dispositions. The besieged work on interior lines, against an enemy who cannot maintain equal strength around the whole circle of investment; and, under an energetic commander, even second-rate troops, on their own ground, are capable of taking the offensive. The success of these offensive movements will depend to a great extent upon the artillery. For it is not desirable for the besieged to engage their troops too closely unless they have a momentary superiority in numbers, since their losses cannot be replaced. They can never hope to obtain a permanent superiority in numbers at any point; hence their offensive movements will be short and sharp, utilizing their full fire-power, and in this the great volume of fire that can be delivered from even a few Q.F. guns will be of the greatest assistance.

Artillery of the Besieger.

In the early stages of the siege the besieging force will be well provided with field artillery. When the

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besieged have been driven into the fortress, or even sooner, the greater part of the field artillery will be withdrawn and used with the covering troops or the field army. At first, therefore, the besieger will have a considerable superiority in field artillery, enabling him to push the preliminary stages of the siege with great vigour. This is of importance, since the more time is allowed to the besieged the more they will be able to strengthen their advanced and main defences.

It will be seen from Fig 124 that the weak point of the defender's first position is the flanks. This position is open to enfilade fire, especially from heavy field artillery, and full advantage must be taken of this. The flanks are supported on points supposed to be protected by the fire of the guns in the forts; but these guns are ineffective in the dark, or even in misty weather, which affords freedom of movement to the attack. The besieger's method is therefore to obtain an enveloping artillery fire upon one of these *points d'appui*, and then to assault it at a moment when it is deprived of the assistance of the artillery in the forts. The besieged will probably not venture to send their searchlight units out as far as the first position, but the forts will certainly have searchlights, and these will have to be reckoned with. Their situation being accurately located, they will not last long under howitzer shrapnel fire.

When the defenders have been driven from their first position, the next proceeding will be the reduction of one or more of the girdle forts in order to make a gap in the girdle line. With this the field

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artillery have nothing to do, except in supporting the assault on the breach. When this is accomplished, the field artillery, if still with the besieging force, will assist to drive the enemy from his third position. The tactics will be the same as before, namely, enfilade and envelopment.

The besieged will have the initial advantage of knowing the ground; the besieging artillery must equalize matters as soon as possible by careful reconnaissance by night and day, until the ground is equally familiar to them.

Field artillery holding points in the line of investment must be thoroughly entrenched, so that they can hold out against a sortie in force till relieved. If obliged to retire they must adopt the "elusive defence" tactics, retiring slowly before the sortie till they reach a strong position, and then holding out till the sortie is taken in flank by the reserves of the investing troops.

To prevent the besieged from reconnoitring and from communicating with their army by dirigibles, the besiegers will be provided with balloon guns at the rate of about one to every mile of the circle of investment. But these will be unable to prevent the movements of dirigibles by night. The aeroplanes of the besieged will be difficult to hit, and it will be practically impossible to prevent them from reconnoitring. But in this respect besiegers and besieged are on equal terms, since aeroplanes can fly over the fortress without much risk of being hit by the defender's artillery.

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Dropping heavy high-explosive shell from dirigibles may possibly be effective, especially against the smaller forts. But this is a siege question, and is beyond the limits of the present book.

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CHAPTER XXVIII.

EMPLOYMENT OF ARTILLERY UNDER SPECIAL CONDITIONS.

Street Fighting.

Because manœuvres are always carried out in open ground, we are apt to forget that a considerable area of the country is covered with towns and villages, and that in war these will be the scene of hard fighting.

When our troops attack a village, the guns outside will have to cease firing as soon as the infantry get in among the houses. But if the village has been prepared for defence, and if buildings are held by the enemy, the infantry will still have the hardest part of their task before them. This is where the advantage of the shielded gun comes in. The guns already acting in close support will now be run up by hand into the streets, and any buildings from which resistance is offered will be fired upon. A detached building like a town hall might easily be made storm-proof and quite impregnable to infantry, but a few rounds from the 18 pr. will render it untenable. Street barricades can be quickly demolished by artillery fire.

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The effect of shrapnel in a street is very great, as the bullets glance inwards from the buildings on either side.

The employment of artillery in the interior defence of a town or village is more difficult. Guns may be strongly entrenched in positions from which they can fire down the principal streets, but no entrenchments will be effective against artillery at short range, and, moreover, it will be difficult to keep the enemy from getting round behind them by cross streets. Unless every avenue of approach can be commanded by a gun, the attacking force are likely to have the best of it.

It should be remembered that the artillery originally entrusted with the defence of a village will not be posted in it, but outside, on the flanks. These guns must be driven back or silenced before the village is captured, except by a night attack; and if they are obliged to retire it is a question whether they will do much good by withdrawing into the village. It will in most cases be preferable to take up positions behind the village, commanding the exits from it.

Woodland Fighting.

Any gunner who expects that on service he will always have a clear range in front of him is likely to be disappointed. The infantry are not so particular as to where they fight. And wherever the infantryman goes, if he requires help the gunner must be there to support him.

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In open woodland or park land the gunner's task is comparatively easy. The ranges are short, but it is always possible to advance and to unlimber under cover. The effect of shrapnel fire upon troops among trees is very good, as the bullets seem to glance in all directions. It will hardly be possible to keep the guns of a battery in line, and it is best to break the battery up into sections or even single guns. In order to avoid shooting our own troops, the guns must trust to their shields and keep well up to the firing line.

In thick woodland the guns will have to be treated simply as machine guns, and run up by hand wherever tracks are available. This is not an ideal method of employing artillery, but it is better than waiting outside and letting our infantry be defeated. The advance will be slow and difficult, and the infantry will have to assist in getting the guns and ammunition along. On the other hand, the effect will be very good, especially if high-explosive shell are used.

Mountain guns are the best to employ for woodland fighting; next to these, howitzers are to be preferred on account of the effect of their powerful shell among the timber.

Defiles.

When the enemy are caught emerging from a defile, the artillery can hardly do wrong if they fire into the defile, searching the whole length of it, and disregarding the fire of the enemy's guns.

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When our own troops are emerging from a defile, the artillery should not come into action in front of it, where shells fired at them will be effective on the troops behind, but on either side. If the enemy's guns are firing, it is important to silence them as quickly as possible; and since long-range fire at shielded guns is ineffective, our artillery must push forward until able to destroy them by direct hits. This may involve considerable risk, but anything is better than leaving the troops in the defile exposed to artillery fire.

A common form of defile is a bridge or ford. When crossing this, artillery should be pushed forward with the leading troops and should be posted so as to clear a semi-circle of 2000 yards radius (long rifle-range) around the bridge-head.

Landing Troops.

When troops are landed it is important to get guns ashore as soon as possible in order to keep hostile artillery out of range of the landing-place.

When resisting a landing, the field guns, if any are present, must endeavour to make direct hits on the launches towing the boats. The guns should come into action close to the beach, well dispersed, and should fire by sections. The risk of direct hits from the enemy's naval guns is small, unless his ships are able to lie close inshore. Even when without gun-shields, sailors' time shrapnel is not likely to be dangerous.

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CHAPTER XXIX.

ARTILLERY IN AERO-NAVAL WARFARE.

THIS term includes the action of guns fired from and at dirigibles and aeroplanes, from each other and from the ground.

Action between Dirigibles.

When hostile airships meet, it is inconceivable that each will go on its way reconnoitring without molesting the other. They must fight; and since ramming or boarding would mean the destruction of both, they must fight with shell, rockets, or bullets. And they will certainly not have any regard to the feelings of the people below, on whose heads the projectiles will fall.

The question of the armament of airships has been discussed in Chapter V., and the technical method of using the guns is described in Chapter X. It has there been shown that a modern military dirigible can carry a 5 pr. gun and 50 rounds, total weight 7¼ cwt. The gun will have a M.V. of 1000 f.s., and be fitted with speed sights corrected for altitude, and ought to make 50 per cent. of hits on a hostile

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dirigible at 1000 yards, and perhaps 10 per cent. at 2000, the accuracy depending not so much on the gun as on the error in measuring and applying the range and speed corrections.

As more perfect weapons are introduced, the range will increase; thus in Nelson's time one cable, or 200 yards, was a fair range, while modern battleships expect to decide the combat before they get within 5000 yards of each other. An airship is a large target, and with the improved weapons, sights, and rangefinders which will no doubt be introduced, there should be no difficulty in hitting her at 3000 yards. It is certain that if one airship can make hits at 3000 yards, another which can only hit at 2000 will stand a poor chance against her. However, we will assume that, for the present, ranges will not much exceed 1000 yards.

The shell will be a high-explosive projectile, with a fuze with whiskers to ensure its acting on the envelope, and will leave a smoke-trail behind it.

The gun will be mounted in the bow or stern of the airship, and will be capable of from 45° to 60° of elevation, 90° of depression, and 270°, or $\frac{3}{4}$ of a circle, of training.

Possibly at some future period airships will have twin hulls, with a fighting deck between them, and will be able to engage an enemy above as well as below. But at present if one airship gets above another she is safe from her fire. Therefore if one airship has greater lifting power than the other, she will endeavo, r to keep out of range while she rises to

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the extremity of her lift, and will then try to get over the other.

Now it will be seen from Fig. 22, page 57, that one airship cannot get over another without coming under fire. Mathematically, if the guns of an airship can fire upwards at 60° and range 1000 yards, then, to keep out of range of them, another airship approaching the first must do so at a level 860 yards, or 2580 feet, higher. And there is not likely to be so much difference in the lift of two military dirigibles.

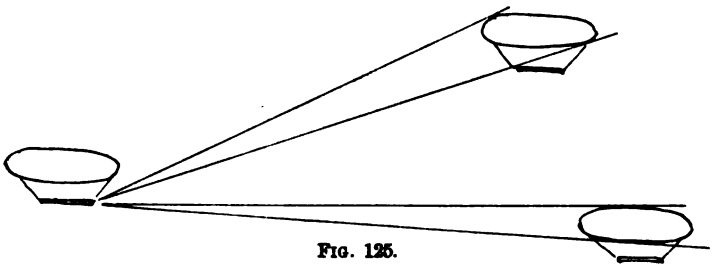

FIG. 125.

Therefore, one dirigible cannot get on top of the other without coming under fire. And as she rises above the other she will expose increased vulnerable surface. This is evident from Fig. 125, which shows that the greater the difference of level, the greater target does each ship present to the other.

The ship which has the greater lift, and which expects to get above the other, will go full speed ahead in order to traverse the dangerous space, within which she is under fire, as quickly as possible. The wind makes no difference, since both are equally affected by it. Suppose the attacking ship does 35 knots, the defending ship, if fitted with a bow gun

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only, will have to go ahead at 5 knots to keep steerage way; therefore the ships will approach one another at 40 knots, and the dangerous space of, say, 1000 yards, will be covered in 45 seconds. This gives no time for putting on speed corrections; however, with both ships travelling end on, the range correction is the only one that need be considered, and, with smart gunnery, it may be possible to get off 10 rounds in the time.

If the defending ship had a stern gun as well as a bow gun, and if her speed were the same as that of the attacking ship, she could keep her distance of 1000 yards, and the attacking ship would never be able to get above her. But a military dirigible of the present type is not capable of carrying both a bow and a stern gun, and the difficulty of providing complete all-round fire with a single gun can only be overcome by providing a double-decked car; that is, a car with a separate gunnery platform suspended beneath it. This may come in time; but it is rather a formidable proposition to tackle, and at present the ideas of practical men do not range beyond a single bow gun, capable of firing round three-quarters of the horizontal circle.

Even with a single gun, there are considerable tactical possibilities. If the ship attacked retires obliquely at 45° to the enemy's course, she will still be able to fire on her, and the time available for firing will be more than doubled. This, of course, assumes that the attacked ship has completed her turn before the enemy arrives within effective range.

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The above elementary calculations regarding aero-naval gunnery are useful in so far as they show what can be done with the gun, if handled to the best advantage. In the same way the tactics of artillery on land are based on the probable rectangle and fire-effect of the gun. But a battle between airships will resemble a naval combat between 30 knot destroyers, with the added complication of a third dimension, and the dominant factor will not be the excellence of the gun, but rather the energy and quick decision of the commander.

Action between Aeroplanes and Dirigibles.

When the aeroplane first appeared as a practical flying machine, we were told that it was going to drive the dirigible balloon from the battlefield; that the active plane would easily rise above its bulky rival, and rip it or drop hand-grenades on it from above. There is no immediate prospect of this happening, At present the balloon can not only rise higher than the aeroplane,[1] but it can rise quicker, and the only tactical advantage of the plane lies in its greater speed and handiness. The helicopter, or the true flying machine, will no doubt introduce a different set of conditions. The gliding machine, as a weight-lifter, is as feeble as a hawk; what the military airman wants is a compact powerful flier on the lines of the wild duck or carrier pigeon. But for the next few years he will have to be content with the glider.

[1] Exhibition flights without a passenger can hardly be accepted as made under service conditions.

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It would no doubt be possible to make an aeroplane large enough to carry a gun, and strong enough to stand its recoil. But this would be an enormous machine, too large to carry with an army in the field, and too clumsy to rise except from a large expanse of open ground. The present type can carry three men at most, and these in a cramped position; it does not afford room to work a gun. It is just possible that a couple of rockets (Chapter V.) might be carried. A fast aeroplane approaching a dirigible end on at full speed might get in a shot with a rocket at close range, but the dirigible, if aware of its approach, could evade the attack by rising.

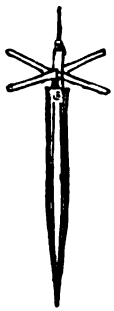

Fig. 126.

Supposing that an aeroplane can approach a dirigible by surprise, and can get above her, she can easily drop grenades. A suitable form is shown in Fig. 126, which represents a light tube filled with explosive, with vanes at the upper end. The vanes are connected by a wire with the fuze; when the grenade is dropped on the balloon the point penetrates the envelope, while the vanes are arrested, and the resulting pull on the wire actuates the fuze. The effect would be to blow a large hole in the upper surface of the envelope, and possibly to set fire to the gas. An even simpler weapon would be four scythe-blades or reaping-hooks fixed together calthrop-fashion in the form of a star. It is very probable that aeroplanes will carry weapons of this sort when hostile dirigibles are

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in the field, in the hope of getting a chance to use them.

If the aeroplane is unlikely to hurt the dirigible, the latter is still less likely to destroy its opponent. The vulnerable target surface is very small; neither rifle fire nor shrapnel bullets will do much mischief, and the only projectile which promises to be effective is the high-explosive shell, with a fuze sensitive enough to burst the shell on the covering of the planes. But the chance of hitting a plane flying 50 miles an hour from a moving dirigible is so small as to render it not worth wasting ammunition in such practice, except at very close ranges.

Action between Aeroplanes.

When hostile aeroplanes meet, they will fight as certainly as hostile dirigibles. Their weapons of offence are more limited, being restricted to rifles, hand-grenades, and the scythe-blade arrangement referred to above. Probably each will try to get over the other and fire down on it, or drop a hand-grenade of the type illustrated in Fig. 126. If this grenade, or the scythe-blade star, were dropped on to the wing of an aeroplane it would certainly do some damage and might very possibly disable her. If neither can rise above the other, the more active plane will try to circle and come up behind the other within a range at which there is a prospect of hitting with the rifle. There is also a possibility of one aeroplane "sinking" another with its down-draught by flying close over it.

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Action of Land Guns against Air-craft.

The weapons employed, and the technical method of using them, have been discussed in Chapters V. and X. Two types have been evolved;[1] the powerful high-velocity 12 pr., fired from a transportable platform; and the light 3 pr., mounted on a fast motor car. The latter, even supposing its fire to be effective, is not likely to be of much use for chasing dirigibles, as its point-to-point speed over encumbered roads will probably not exceed 20 miles an hour. Some early balloon-chasing cars were armoured, the object of the armour being principally to add weight and afford a steady gun-platform. There can be no possible object in armouring a car for protection against fire from balloons. No ordinary chassis would stand the recoil of even a 3 pr. gun if the recoil gear used in field guns were employed. The difficulty has now been got over by the use of differential recoil gear (Chapter I.), which reduces the recoil-energy by 75 per cent.

The high-velocity 12 pr., and the method of ranging with it, have already been described. This gun is brought into action in a central position, affording a clear view all round. Since it is much easier to observe the smoke-trail from a flank than from the gun itself, three or four observers are posted round it at distances of about a quarter of a mile, so that, from whichever direction the air-craft

[1] The 40 pr. gun of position, on permanent mounting, is not here considered.

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approaches, a flank observer will immediately be available. Telephonic communication is unnecessary, as the observer simply signals "high" and "low" with a flag.

Since the radius of effect of the 12 pr. balloon gun is about 6000 yards, it will rarely be necessary to shift it during an action. Two such guns per division is considered the proper number; there is little to be gained by keeping them together, and they will be posted about 3000 yards apart.

Shooting at dirigibles will be no easy matter. The mere gunnery difficulties can be overcome by the use of suitable sights and rangefinders, as already described; the difficulty will be first in seeing the dirigible, and then in identifying her. It is very common, even in summer, to find a stratum of clouds overlying the earth at a height not exceeding 3000 feet. When this is the case, the dirigible will steer by compass and log for the centre of the enemy's position, drop through the clouds, take a couple of photographs, and will then throw out ballast and rise again before she can be fired at. In close country, where the horizon is limited, the dirigible will work to windward of the enemy, and then turn down wind and come over his lines at full speed, flying low over the tree-tops so as not to come into view of his guns till within a few hundred yards of them. The gunner will only have a few seconds to decide whether she is an enemy or no. Differences in the colour of the envelope are not to be relied upon, since unless the sun is shining all objects in the sky look much

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the same colour. No doubt our own dirigibles will fly private signals when over our lines, but these, being conspicuous at a distance, can easily be imitated. The most promising method is to make our own dirigibles adhere to certain times and certain courses when over our lines, and to communicate these to our gunners. For instance, in a fight at Aldershot, it might be notified in operation orders that "Red airships, when over our own ground, will fly at a height of 500 feet, keeping to the line of the FARNHAM-FARNBORO road." The Navy experience similar difficulties with their own torpedo boats in night work, and we shall have to use the same means of overcoming them.

Airships will frequently reconnoitre at night, in order to observe the enemy's dispositions as betrayed by his bivouac fires. Also it is quite possible that an airship, for night work, will leave her gun behind and take up instead an acetylene searchlight, or even an electric searchlight worked by her own engines. Except when this is turned on, or in bright moonlight, she will be a mere shadow overhead. Even if she be detected and a searchlight turned on her, she will be far more difficult to hit than a torpedo boat.

The action of airships against artillery is hardly worth considering. A field gun or balloon gun offers a small mark, and an airship would not be likely to waste ammunition on the chance of hitting it. Practically the only time when it is worth the airship's while to fire at troops on the ground is when these

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can be engaged *en masse* by dropping large shrapnel. This subject will be considered separately.

Aeroplanes, when these fly low, can be engaged with ordinary field guns and howitzers firing shrapnel, as explained in Chapter X. But the chance of effect is small. The balloon gun, firing high-explosive shell, may possibly score a hit, but the target is a minute one compared to a dirigible. Their tactics will probably be bolder than those of balloons; they will fly at heights not much exceeding 1000 feet, and will take their chance of being hit. Their offensive power against troops on the ground is negligible.

Dropping Shells and Explosives.

The technique of this subject has been discussed in Chapter V. If we accept the estimate that an airship can carry, at least temporarily, 900 lbs. of ammunition, this means, say, ten 90 lb. shrapnel, each containing 1260 16-gramme bullets, 28 to the pound. One of these burst over an artillery or cavalry camp, or over Army headquarters (if these are in the open) would do considerable damage. If the enemy be properly equipped with balloon guns, the airship will hardly attempt shell-dropping by daylight, but it may take its bearings by day and return to drop shells by night. Thus an effective preliminary to an attack on an entrenched position at dawn would be to send an airship down the enemy's line at 10 p.m. and again at 2 a.m., each time dropping ten 90 lb. shrapnel at intervals of 300 yards. This would give the defenders an uncomfortable night.

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The offensive tactics of airships are dependent on the weather. It is not so much that the airship, when in the air, is endangered by wind; the difficulty is in ascending and descending, except in calm weather. The airship cannot be expected to carry about 900 lb. of ammunition for an indefinite period, and she cannot reckon upon being able to descend and embark ammunition at any given place and time. Moreover, after dropping 900 lb. of dead weight the airship will have to blow off a considerable volume of gas to come down, and this gas will have to be replaced[1] before she can rise with a fresh cargo. Therefore the assistance of the airship in the combat, although it may possibly be of great value, can never be counted upon as a certainty.

It will never be worth while for the airship to drop high-explosive shell or other **explosives** upon troops in the open,[2] as the effect is very local. But, as has been explained under *Reconnaissance*, airships will be employed, on the outbreak of war, for the strategical reconnaissance of the enemy's country. And it may be worth while to carry explosives on such an expedition. For a long voyage, ballast will have to be carried, and this may just as well be dynamite as sand.

The popular idea of the effect of explosives in destroying arsenals and dockyards is much exaggerated, and the cargo of one airship dropped, say, into

[1] This is now facilitated by the process of making hydrogen on the spot by treating powdered ferro-silicon with caustic soda.

[2] Siege work is not considered in this volume.

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Woolwich Arsenal would make little difference in the out-turn. Even in a crowded city the wholesale destruction depicted by popular novelists would be impossible with the explosives at present known to science. It is not generally realized that even pure nitro-glycerine, which is the strongest explosive in practical use, is only three times as powerful as black powder. The energy stored up in a pound of powder is considerably less than that in a pound of coal.

In London, the places selected to drop shells into would probably be the Houses of Parliament and the Stock Exchange, but the military effect of such action, even if it were considered legitimate warfare, would be inconsiderable, while the political effect would not be in the direction of peace or surrender. Still, it is the duty of every nation, in order to avoid such insults, to provide ordnance and airships of its own, capable of dealing with invading air-craft.

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INDEX.

A	PAGES
Accuracy of Fire	136, 160
at guns in the open	136, 297
at dirigibles	64
Acetylene	
searchlight	353, 378
signalling lamps	115
Action	
advance into	264, 317
coming into	267
formations in	143-147
Advance into Action	264
under fire	317, 318
Advanced Guard	256
artillery with	326
duties of	327
composition of	326
various kinds of	326
at night	352
Advanced Observing Party	176
Advanced Sections, see *Close Support.*	
Aeronaval Gun	56
accuracy	59, 64
ammunition	60
director	59, 68
range of	64
rangefinder	58
recoil gear	65, 67
proposed design for	67
sights	57, 68
weight	63
Aeronaval tactics	56, 369
Aeroplanes	
armament	72, 374
dropping shells from	85
attack on	81
ranging at	192
Aeroplanes	
tactics in reconnaissance	245
attack	342
defence	336, 342
encounter	348
fortress warfare	361, 363
versus aeroplanes	375
„ dirigibles	373
„ land guns	376
Aiming Point	155
Aiming Posts	116, 152
Airships, see *Dirigibles.*	
Aluminium cartridge cases	65
Ammonal	88
Ammunition	86
aeronaval gun	60, 65
balloon gun	60
cartridge	87
exploder	89
explosives	88
fixed	86
fuzes	93
powder	86
primer	87
high-explosive shell	88
mine shell	88
segment shell	93
shrapnel	87
star shell	93
universal shell	91
Ammunition	
amount carried	216, 222
destroying	207
replenishing	180
Ammunition Columns	216
organization	219
duties	219

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	PAGES
Ammunition Columns	
for mountain artillery	50
cavalry raid on	308
tactics in attack	346
defence	338
retirement	329
Ammunition Supply	
in division	221
foreign armies	222
attack	346
defence	337
retreat	329
Ammunition Wagons	32, 218
position in action	144
on the march	218, 258
Angle of Sight	156
Arc Sight	16
Arms	
rifles	111
pistols	111
Armstrong	
gun	7
60 pr.	42
mountain howitzer	53
breech actions	13, 14
hydropneumatic gear	27
fuze	95
shrapnel	88
pointed shell	91
Army, Artillery of	1
Army Corps	213
Army Troops	214
Artillery	
of field army	1
natures of	1
organization of	212
territorial	214
proportion to infantry	213
command	223
orders	224
draught	97
stores	111
camps and quarters	249
entrenchments	197
fire	122
fire discipline	142
formations in action	143
of manœuvre	261
positions	269
tactics, see *Tactics.*	
transport by rail	211
Assembly for March	260
Attack, tactics in	340-346
decisive	337, 341
by night	349
Austrian	
gun	101
sights	16
mountain equipments	313
Automatic Breech Action	15
Automatic Sight, Scott's	20
Auxiliary Mark	155
Axletree	4, 30
for mountain howitzer	53
seats	30, 102
B	
Ballistite	87
Balloons, captive	
ranging at	188-192
observation from	179
reconnaissance from	245
photographs from	245, 342
Balloons, dirigible, see *Dirigibles.*	
Balloon Gun, see also *Aero-naval Gun*	56, 73
ammunition for	60
Ehrhardt	77
Krupp	74
Schneider	77
Vickers Maxim	77
French	78
sights for	79
rangefinder for	80, 189
Balloon Guns	
fire discipline	188
tactics	376
use in attack	344
defence	336
fortress warfare	363
at searchlights	358
Battery	
organization	216
strength	216
four or six guns	217
Battery Commander	
duties in action	267
target reconnaissance	239
Battery Formations	
in action	144
of manœuvre	261
in advance into action	266

Digitized by Google

PAGES

Battery Leader - 146, 154, 266
Billets - - - - - 248
Bivouacs - - - - 250
Bombardment - - - 344
Bracket
  long and short - - - 160
  unreliable - - - - 162
Brake - - - - - 4, 6
Breech action
  automatic - - - - 15
  semi-automatic - - 15, 67
  eccentric screw - - - 12
  interrupted screw - - 9
  swinging block - - - 11
  wedge - - - - 13
  Welin screw - - - 12
  for howitzers - - - 37
    aeronaval gun - - 68
    balloon gun - - - 75
Brigade, artillery
  organization - - 2, 216
  command in - - - 231
  formations in action - - 142
  formations of manœuvre - 262
Brigade Commander (artillery)
  duties of - - - - - 229
  reconnaissance by - - 237
  in the advance into action - 264
  reports to - - - - 238
  communication with batteries 231
  communication with infantry 320
Buffer - - - - - - 3
Bullets
  penetration of shields - 31
  shrapnel, see *Shrapnel Bullets.*

C

C.R.A. - - - - - - 223
  duties in reconnaissance, 227, 233, 235, 264
    before the combat - 227
    in deployment - - 268
    the combat - 225, 227
    attack - - - 343
    defence - - 336
    independent command - - 343
  post on the march - - 258
    in action - - - 237
  orders issued by - 224, 226
  communication with brigades 228

PAGES

Camps and Quarters - - 248
Camps, laying out - - 251
Captain, duties of - - 180, 267
Carriage
  general description - - 3
  parts of - - - - 5
  steadiness - - - - 29
Carrier transport, - - - 53
Cartridge - - - - 87
  aluminium - - - 65
Casemates - - - - 203
Casualties - - - - 181
  to horses - - - - 206
Caterpillar Tractor - - 103
Cavalry
  attack by - - - - 173
  brigade - - - - 214
  tactics - - - - 308
  combat - - - - 309
  raids - - - - - 308
  dismounted - - - 309
  artillery *versus* - - - 305
  horse artillery with - - 306
Change of position - 170, 265
Châtillon Mountain Gun - 51
Clinometer - - - 4, 6, 23
Clock code - - - - 148
Close support of Infantry, 285, 322, 345
  in mountain warfare - - 311
Column
  of march - - - - 256
  battery - - - - 261
  of sections - - - - 262
    subsections - - - 261
    route - - - - 261
  deployment from - - 263
Combat reports - - - 238
Command
  in the division - - - 223
    brigade - - - 231
    battery - - - 231
  detached forces - - 230
Communication
  in the division - - - 228
  with infantry - - 239, 320
  in night attack - - - 356
Communication centres - - 228
Communication companies - 215
  on the march - - - 258

Digitized by Google

	PAGES
Compass, laying by	158
Compressed air gear	27
Concealed Position	
varieties of	275
occupation of	267
laying from	151
as reserve of fire-power	272, 301
discovered by aeroplanes	273
dead ground in front of	277
versus open position	271, 281
attack of guns in	300
Concentration of Fire	169
Controlled Recoil	27
howitzer	36
Cordite	87
Corps Artillery	213
Corrector	117
Counter Attacks	333, 338
repelling	346
Counter batteries	289
Coventry Ordnance Works	
breech action	10
howitzer	39
sight	23, 25
limber	32
wagon	33
high-explosive shell	90
shrapnel	90
Cradle	3, 4
of aeronaval gun	68
Crest of position	331
Crowning the position	345
Cutting off the point of assault	343

D

Dangerous Zone	122
Dead Ground	
at foot of forward slope	199, 335, 345
in front of concealed position	277
Decimal system of graduating sights	25
Defence	
tactics of artillery in	332
advanced	331
of main position	334
by night	351
Defiles	367
Deflection	18, 150
by card or knuckles	151
Deployment	263
Deport Mountain Gun	51
Destroying Guns	206-208
Detachments, carrying	102
Detonation	89
Dial Sight	4, 6, 21
use as director	158
Differential Recoil	
for mountain guns	50, 51
aeronaval guns	65
balloon guns	75
Diplock's Pedrail	106
Direct Hits	296
Director	115
aeronaval	59, 68
use of	152
Dirigibles	
German	65
Gross	73
Parseval	73
Zeppelin	72
armament of	56, 65, 67
rockets as armament	70
fire from	69, 193, 371
dropping shell from	81, 83, 193, 379
explosives from	84, 193, 379
tactics of	56, 369
reconnaissance from	245, 380
versus aeroplanes	373
attack on, guns for	72-78
ranging at	189
versus land guns	376
in fortress warfare	361, 363
Displacement	154
Distances on the March	259
Distribution of Fire	169
Double Chain Signalling	231
Draught	97
detachments	102
distribution of weight	99
harness	97, 100
heavy guns	101
horse artillery	101
howitzers	101
mountain guns	48
pole	99
shaft	99
springs	98
travelling position	99

Digitized by Google

PAGES

Draught
- weights - 100
- wheels - 98
- mechanical traction - 102

Drift - 7
- allowance on sights - 16

Dropping explosives 83, 173, 379

Dust
- on firing - 204
- in advancing - 267

Dynamic cradle - 28

Dynamite - 381

E

Echelon - 261

Ehrhardt
- balloon gun - 77
- field gun - 12
- universal shell - 93

Effect, fire for, see also *Fire-Effect* - 166

Eighteen-pounder gun
- parts of - 5
- breech action - 12
- recoil gear - 26
- sights - 18, 20
- accuracy - 136, 297
- effect on houses - 129
- shielded guns - 297

Electric
- fuze - 61
- road train - 107

Elevating screw - 3, 30

Emplacements - 197

Encounter - 347

Enfilade fire - 137

Entraining - 211

Entrenchments - 197-205
- in mountain work - 311

Equipment - 1
- weights and dimensions - 34

Escorts - 304

Exploder - 89

Explosives - 88
- dropped from airships 83, 173, 379

Extractor - 11

F

PAGES

False Crest - 175

Field gun, see *Gun*.

Fifteen-pounder Gun - 12

Fighting Battery - 261

Fighting March - 255

Fire of Artillery - 122
- effect of, see *Fire-Effect*.

Fire, massing - 283

Fire, neutralizing - 282

Fire, rate of - 15, 281
- tactical - 282

Fire-discipline - 142-196
- of horse artillery - 183
  - howitzers - 183
  - mountain guns - 185
  - heavy field guns - 186
  - balloon guns - 188
- French - 194
- German - 195

Fire-effect
- on ammunition boxes - 134
  - houses - 134
  - overhead cover - 133
  - shielded guns - 296
  - walls - 129
- of shrapnel - 123
  - percussion shrapnel - 129
  - howitzer shrapnel - 297
  - H.E. shell - 133, 299
  - 18 pr. gun - 129

Firing Gear - 10
- German - 14

First-line Wagons - 261
- in action - 144
- on march - 218, 258

Flank Observing Party - 176

Flash
- cover required to conceal - 300

Formations - 143
- in action - 144-147, 187
- of manœuvre - 261
- in advance - 266

Fortress Warfare - 359-364

Freibahn Road Train - 107

French
- aeroplane - 246
- balloon gun - 78
- mountain gun - 50

Digitized by Google

	PAGES
French	
Rimailho howitzer	44
recoil gear	26
traversing gear	3
gun detachments	102
fire discipline	194
tactics	288, 322
in fortress warfare	359
Frontage	
of division	269
position	332
target,	282, 285, 338
in camp	250
Fuze	93-96
clockwork	96
electric	61
mechanical	95
percussion	93
time and percussion	95
sensitive	61
Fuze Corrector	117
use of	165
Fuze Echelon	165
Fuze Key	118
Fuze-setting Machine	33, 118
G	
General Service Wagon	120
German	
dirigibles	65
field gun	17
fire discipline	195
gun-detachments	102
heavy field howitzer	48, 101
light ammunition column	218
recoil gear	25
system of draught	97
tactics of artillery	293
Girdles	43
Goerz Panorama Telescope	21
Grenades	
carried by aeroplanes	72
Ground Scouts	267
Gun	
general description	3
parts of	4
construction	6
material	6
section of	7
length	7
calibre	7
rifling	7
weights and dimensions	34
breech action	9-15
horse artillery	46
mountain	47
Gun-recoil Carriage, see *Carriage*.	
Gun Epaulments	198
with overhead cover	201
Gun Fire	167
Gunpits	199
Guns, Destroying	206-208
Guns, Shielded	
attack on by artillery	296-301
infantry	303
Guns, Slinging	210
H	
Harness	97, 100
casualties to	208
Heavy Field Artillery	
organization	262
fire discipline	186
formations in action	187
of manœuvre	262
ammunition columns	219
tactics	287
Heavy Field Gun	
description	40
60 pr.	41
Armstrong	42
Krupp	40
draught	101
Height of Burst	125
Heliograph	114
High-explosive Shell	50, 75, 88, 90
fire	133
effect	134
Horse Artillery	
gun	46
fire discipline	183
tactics	287
with cavalry	306
in cavalry combat	309
raids	308
seizing positions	309
holding sham position	309, 333
in pursuit	310
use at night	310, 351

Digitized by Google

PAGES

Horses
forage - - - - 250
watering - - - - 254
stabling - - - - 249
encamping - - - - 250
picketing - - - - 251
billeting - - - 249, 250
swimming - - - - 210
entraining - - - - 211
casualties to - - - 208
Howitzers
fire discipline - - 183, 186
shrapnel fire - 130, 132, 297
H.E. shell fire, - - 134, 298
fire at shielded guns - - 297
tactics - - - - 286
Howitzer, Q.F. Field - - 35
ammunition - - 90, 130
ballistics - - - - 35
charges - - - - 131
construction - - - 36
recoil gear - - - - 36
limber - - - - 37
draught - - - - 101
use as gun - - - - 36
Howitzer, Heavy Field - - 43
German - - - - 45
Rimailho - - - 44, 101
Krupp - - - - 45
Vickers Maxim - - - 43
ammunition - - - 90
charges - - - - 130
draught - - - - 101
Howitzer, Mountain, see *Mountain Howitzer.*
Hydraulic Buffer - - - 3, 25
Hydropneumatic Recoil Gear 26

I

Implements - - - - 119
Incendiary shell - - - 60
effect of H.E. shell - - 134
Independent Line of Sight 16, 18
Infantry
action against guns - - 303
co-operation with artillery 315, 320
firing lines - - - - 301
fire-power - - - 302, 303
tactics in S.A. War - - 302
artillery *versus* - - - 301

PAGES

Infantry
batteries - - - - 289
communication with - 239, 321
firing over - - - - 139
protection of - - - 316
support of - - 239, 315-325
proportion of guns to - 212

J

Jumping the Range - - 162

K

Kite
observing from - - - 180
reconnaissance from - - 246
Kitchens, Travelling - - 121
Knuckles
use in measuring deflection 151
Krupp
heavy field gun - - - 40
howitzer - - - - 38
heavy field howitzer - - 45
mountain gun - - - 50
mountain howitzer - - 53
balloon gun - - - 74
effect of - - 76
breech action - - - 13
automatic - 15
clockwork fuze - - - 96
percussion fuze - - - 94
progressive detonation - 89
sights - - - - 20
universal shell - - - 92

L

Ladder, observation - - 113
Lamp signalling - 115, 215, 356
Landing Troops - - - 368
Laying
direct - - - - 150
indirect - - - - 151
stores for - - - - 115
Limber - - - - - 31
Limber-hook - - - - 4
keyless - - - - 32
Limber Supply - - - 183
Line, finding - - - 152
Line, formation - - - 261
of battery columns - - 262

Digitized by Google

PAGES

Liquid Air - - - - 69
Lyddite - - - - 88

M

Manœuvre - - - - 261
Map, laying by - - - 158
March
assembly for - - - 260
of a division - - - 256
distances - - - - 259
fighting - - - - 255
deployment from - - 263
night - - - - 350
Mass, formation - - - 262
Massing Fire - - 283, 300
Mechanical Fuzes - - - 95
Mechanical Traction - - 103
See also *Transport.*
Megaphone - - - - 115
Mekometer - - - - 116
Melinite - - - - 88
Methods of Fire - - - 167
Montluçon, see *Châtillon.*
Morse Code - - - - 114
Motor Cars - - - - 216
Motor Cycles - - - 215
Motor Transport - - - 102
Mountain Artillery
fire discipline - - - 185
formations - - - 263
in action - - - - 185
pace - - - - - 263
tactics - - - 287, 310
in the plain - - 313
in close support - 314
on forward slope of position - - 337
Mountain Gun, Q.F.
Deport - - - - 51
Ehrhardt - - - - 47
French - - - - 50
Krupp - - - - 50
Russian - - - - 47
Vickers Maxim - - - 50
description - - - 47
construction - - - 48
mule transport - - - 47
draught - - - - 48
sights - - - - 49

PAGES

Mountain Gun, Q.F.
shield - - - - 49
ammunition - - - 48
ammunition column - - 50
weights and dimensions - 51
Mountain Howitzers
object of - - - - 311
tactics of - - - - 312
Mountain Howitzer, Q.F. - 51
Armstrong - - - 53
Krupp - - - - 53
Mountain Warfare - 310-313
Austrian views on - - 312
Mounted Brigade - - - 214
Mule, load of - - - 47

N

Neutralizing Fire - - - 282
of counter-batteries - - 290
Night Firing - - 139, 355
searchlights - - 139, 353
star shell - - - - 140
in pursuit - - - - 310
Night Operations
artillery in - - 349-358
in the future - - - 349
occupation of position - 278
sketches for - - - 244

O

Oblique fire - - - - 137
Observation of Fire - - 173
advanced O.P. - 176, 179, 239
flank O.P. - - - - 176
captive balloon - - - 179
kite - - - - - 180
ladder - - - - 112
wagon - - - - 112
cross method - - 177, 187
Obstacles, crossing - - 209
Occupation of Position - 267, 277
by night - - - - 279
Officers'
patrols - - - - 234
posts in action - - 143-147
manœuvre - - 266
Open Position
varieties of - - - 274
versus concealed - - 271, 281

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PAGES

Operation Orders - - 224, 320
Orders
system of issuing - - 224
during combat - - 229
Outposts - - - - 252
Overhead Cover - - - 201

P

Pace
marching - - - - 254
of manœuvre - - - 262
Pack Artillery, see *Mountain Gun.*
Pack Transport - - - 47
Panorama Sight - - - 21
Panorama Sketch
for pointing out targets - 149
fire-commander's - - 242
with reconnaissance report- 243
Patrols, Officers' - - - 234
Pedrail - - - - - 106
Percussion Shrapnel Fire - 129
Pertite - - - - - 88
Petrol, supply in war - - 110
Photography from Balloons 245, 342
Picketing Horses - - - 251
Picric Acid - - - - 88
Plotter - - - - - 115
use for finding range and line 155
pointing out targets 149
Pointed Shell - - - 91
Pointing out Targets - - 147
Position of Observation - 289
Position of Readiness - 236, 289
Positions - - - 269-279
ideal - - - - - 269
qualities of - - - 270
open *versus* concealed 271, 281
varieties of open - - 274
concealed - 275
change of - - - 170, 265
occupation of - - 267, 277
by night - 278
attack on - - - - 340
defence of - - - - 331
extent of - - - - 332
use in war - - - - 330
Portable Guns - - - 53

PAGES

Powder - - - - - - 86
strength of - - - 381
variations in - 141
Primer - - - - - 87
Probability of Hitting, see *Accuracy.*
Protecting Artillery - 316, 325
Pursuit
horse artillery in - - 310
tactics of - - - - 310
night firing in - - - 310

Q

Q.F. field gun - - - 2
howitzer - - - 35
mountain gun - - 47
Quarters - - - - 249

R

Rafale - - - - - 194
Rail, transport by - - 211
Rail-head - - - - 220
Ramps - - - - - 211
Rangefinder - - - - 116
for aeronaval gun - - 58
balloon guns - 80, 189
Ranging - - - - 159
for fuze - - - - 164
at moving targets - - 172
air-craft - - - 188
traps - - - - - 175
Rate of Fire - - - 15, 281
tactical - - - - 282
Rear Guard - - - - 257
artillery with - - - 329
Rear Trunnions - - - 36
Reciprocating Sights - - 16
Reconnaissance
theory of - - - - 306
strategical - - - 233, 380
distant - - - - 234
of battlefield - - - 235
target - - - - 237
during combat - - - 238
duties of C.R.A. in - - 233
patrols - - - - 234
reports and sketches - - 240
by advanced guard - - 328
from balloons and aeroplanes 245
kites - - - - 246

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PAGES

Recoil Gear - - - 3, 4, 25
German - - - - 25
hydropneumatic - - 26
controlled - - - - 27
differential - - - 28
howitzer - - - - 36
of aeronaval gun - 65, 67
Renard Road Train - - 107
Repairs under Fire - - 182
Reserve of Artillery
German regulations - - 293
in defence - - - - 338
attack - - - 340, 346
Retirement - - - - 329
Rimailho Howitzer - 44, 101
Road Trains - - - 107, 121
Rockets
as armament of aeroplanes - 374
dirigibles - 70
Running-up Gear - - 3, 4, 25

S

Salvoes - - - - - 167
Scott, Colonel - - - 20
Scouting - - - 233, 247
Schneider
field gun - - - - 29
balloon gun - - - 77
recoil gear - - - - 27
fuze - - - - - 94
fuze-setting machine - - 119
Schneider-Danglis Mountain Gun - - - 47, 50
Searching - - - 166, 167
Searchlight - - - 139, 353
in attack - - - - 355
defence - - - - 356
fortress warfare - 361, 362
Second-line Transport - - 120
cavalry raid on - - - 308
Section Control - - - 171
Section Fire - - - - 167
Segment Shell - - - 93
Semaphore - - - - 114
Semi-automatic Breech Action 15
for mountain guns - - 50
aeronaval guns - - 68
Semi-concealed Position - 275

PAGES

Semi-mountain Equipments - 312
Sham Position - - - 333
Sheaf of fire - - - - 160
Shell
high-explosive 60, 75, 86, 90
shrapnel, see *Shrapnel*.
incendiary - - - - 60
mine - - - - - 88
pointed - - - - 91
segment - - - - 93
smoke-trail - - 62, 75, 76
star - - - 93, 140, 356
universal - - - - 91
dropped from airships 81, 83, 193, 379
Shell Fire - - - - 133
at houses - - - - 134
ammunition boxes - 135
shielded guns - - 298
Shelter in bivouac - - 252
Shield - - - - - 4, 6, 31
of mountain gun - - 49
observation ladder - 113
penetration by bullets - 31
Shielded Guns
attack of, by artillery 296-201
infantry - 303
Shimosé - - - - 88
Shrapnel - - - - 87
dropped from airships 84, 193, 379
smoke composition - - 88
base burster - - - 123
Shrapnel Bullets
sizes of - - 124, 128, 132
Shrapnel Fire - - - 122
at shielded guns - 126, 296
bullet-zone - - - 128
of howitzers - - 129, 130
heavy guns - - - 128
percussion - - - - 129
Sieges, see *Fortress Warfare*.
Sight, independent line of 16, 18
Sights - - - - 4, 6, 16
Scott's automatic - - 20
Goerz panorama - - 21
Zeiss - - - - - 22
dial - - - - - 21
for aeronaval gun - 59, 68
balloon guns - - 79
Krupp's - 79

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PAGES

Sights
for shell-dropping - - 82
graduation of - - - 20
Signalling - - - 114, 232
double chain - - - 231
Sixty-pounder - - - 41
Sky-line
crossing - - - - 267
entrenchments on - - 274
Smoke composition - - 88
Spade - - - - 3, 6, 30
Springs
running-up - - - 26
draught - - - - 98
suspension - - - - 98
Stabling - - - - 249
Star Shell - - 93, 140, 356
Steadiness of Carriage - - 29
Stereoscopic Rangefinder - 116
Stores, Artillery - - - 111
observation - - - 112
communication - - - 114
telephone - - - - 111
laying - - - - 115
miscellaneous - - - 119
transport of - - - 119
Street Fighting - - - 365
Sun, laying by - - - 158
Support of Infantry - 239, 315-325
Surprise Opening of Fire - 301
Sweeping - - - - 169
Swimming Horses - - 210

T

Tactics of Artillery
modern Q.F. - - - 280
French - - - 288
German - - 293
of field guns and howitzers 286
horse artillery - 287, 306
heavy field artillery - 287
mountain artillery- 287, 310
against various arms - 296-305
in reconnaissance - - 306
advanced and rear guards 326
attack - - - 340-346
defence - - - 333-336
encounter - - 347, 348
fortress warfare - - 359

PAGES

Tactics of Artillery
in reconnaissance
street fighting - - 365
woodland fighting - - 366
defiles - - - - 367
landing troops - - 368
night operations - 349-358
aeronaval warfare - 369-381
co-operation with infantry 315, 320
support of infantry - 315-325
close support of infantry 285, 322, 324
protection of infantry 316, 325
Target front - - - 282, 285
Targets
allotment - - - - 343
distribution - - - 170
pointing out - - - 147
change of - - - - 170
moving - - - - 172
reconnaissance of - 237, 239
Telegraph, Field - - - 215
Telemeter - - - - 116
Telephone, Field - - - 215
stores - - - - 111
brigade - - - - 231
Telescopic Sight - - - 16
Tents - - - - - 248
Territorial Artillery - - 214
Thirteen-pounder - - - 46
effect on buildings - - 129
Time Shrapnel Ranging - 162
Tir Progressif - - - 194
et fauchant - - - 195
against dismounted cavalry 305
Tools - - - - - 119
Trail - - - - 4, 6, 30
Transport
horse-draught - - - 97
pack - - - - - 47
mechanical - - 102, 121
road train - - - 107, 121
subsidized - - - - 109
second-line - - - 120
of artillery by rail - - 211
cavalry raid on - - - 308
Traversing - - - - 3, 30
French system - - - 3
Tribol - - - - - 89

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	PAGES
Trilite	89
Trinitrotoluol	88
Trip-lock	11
Trotyl	89
Twydall Parapet	203
U	
Unge Rocket	70
Universal Shell	91
V	
Van Guard	256
Verifying Range	161
Vertex Angle	157
Vickers Maxim	
heavy field howitzer	43
mountain gun	50
portable gun	55
balloon gun	77
hydropneumatic gear	27
Villages, fighting in	365
W	
Wagon Shelter	252
Wagons	
ammunition, see *Ammunition Wagon.*	
general service transport	120
motor	121
Watering Horses	254
Wedge breech action	13
Wheel	
size of	29
construction	31
spring	98
ball bearings	98
Wind Corrections	137
Wireless Telegraphy	215
from air-craft	349
Wire-wound gun	6
Woodland Fighting	366
Z	
Zeiss zig-zag sight	22

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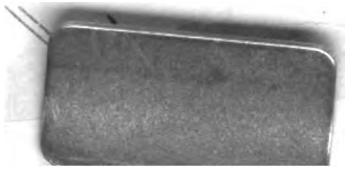

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